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THE COMING OPPOSITION OF EROS

By G. VAN BIESBROECK.

Astronomers have given lately a good deal of attention to planning a campaign for observing the close approach to the earth of the asteroid Eros this winter. No other known asteroid ever comes as close to the earth as this small body, which carries number 433 in the constantly lengthening list of asteroids, of which there are over 1150 well identified at the present time. The discovery of it dates back to 1898 when on August 13, G. Witt in Berlin noticed on a celestial photograph the trail of a moving object, the brightness of which corresponded to that of an 11^M star. The unusual character of this asteroid was shown by its rapid motion across the star field due to its proximity to the earth. Soon the orbit was computed with the result that Eros proved to have a period of only 21 months, which means that its average distance from the sun is less than that of Mars, whose period is 22½ months. But the most remarkable point was the fact that on account of the high eccentricity (0.22) of the orbit this planetoid can come closer than any other to the earth. The inclination of the plane of the orbit was found to be 11 degrees on that of the earth and this, combined with the appreciable eccentricity, produces considerable differences in the distance from one opposition to the next.

Numerous observations were gathered early after the discovery so that good determination of the orbit soon became possible. This showed that the object had been well in reach of photographic instruments in the past and led to its identification on many plates taken as far back as 1893 at the Harvard College Observatory and at their southern station at Arequipa, Peru. These additional data confirmed the results of the preliminary computation and made it possible to establish a much improved orbit. The future course of Eros could now accurately be predicted and the interest in this object was greatly enhanced when it was noticed that the 1900-1901 opposition would fall near the time of perihelion, thus bringing the planet within one-third of the distance of the Sun, which is considerably less than any other asteroid had ever been known to do. This would afford an unexpected way of measuring with greater precision the dimensions of the solar system expressed by the fundamental constant of the solar parallax. So far this constant had been determined first by measuring the parallax of Venus at the rare occasion of its transit over the Sun, later and more successfully by determining the parallax of Mars or better yet of some of the nearer asteroids which can be measured with the same precision as stellar im-

ages. Eros offered the best opportunity for applying this method since the parallactic shift at the time of the minimum distance from the earth in 1900 would amount to three times that of the Sun. Elaborate preparations were made; international conferences gathered to discuss the best ways of carrying out the program. The solar parallax of 8″.807 determined by Hinks from a laborious discussion of the 1900-01 material has ever since been considered as the best value available. Since then Eros has been kept under observation at each of its 17 oppositions since the discovery and no other asteroid has had its orbit determined with

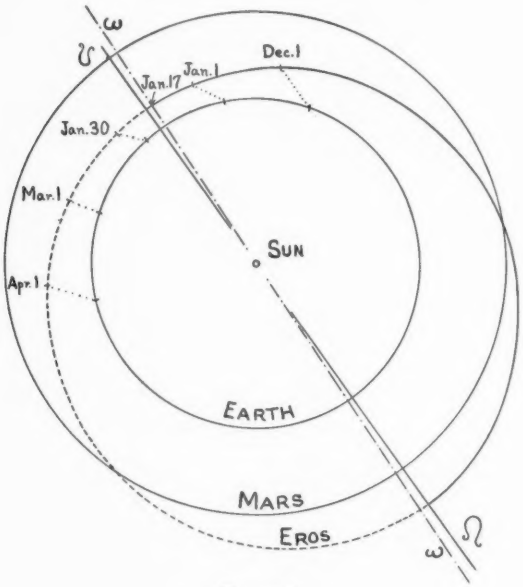


FIGURE 1.
ORBIT OF EROS, MARS, AND THE EARTH
PROJECTED ON THE ECLIPTIC.

greater accuracy. Incidentally this work has furnished the best available determination of the combined mass of the earth and the moon, which has been deduced from the appreciable perturbation in the motion of Eros resulting from the earth's attraction.

Renewed interest has lately been awakened in Eros, due to the fact that this winter will bring the planet nearer to the earth than has ever been observed. The opposition comes on 1931 February 17, one month only after perihelion so that the approach is nearly as close as it can ever become. The minimum distance from the earth is reached January 30 when the separation is reduced to 16 million miles, about one-

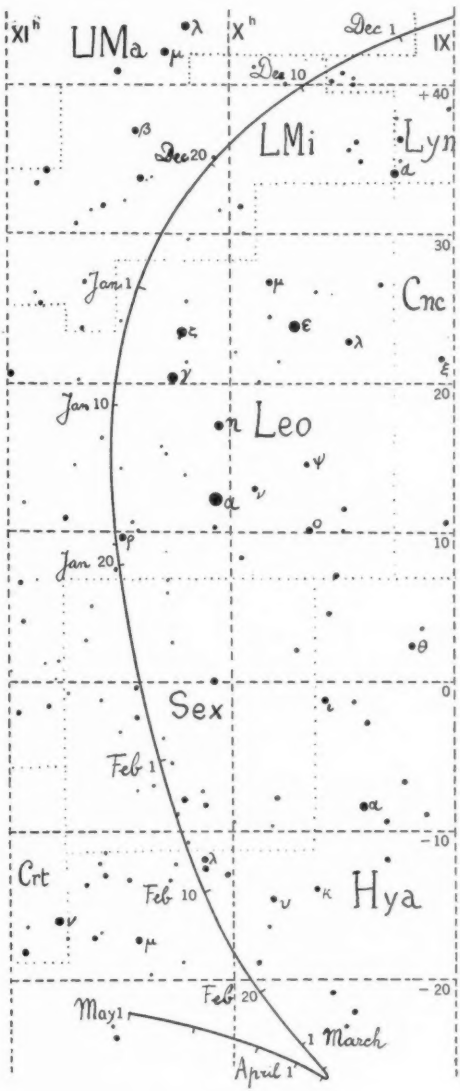


FIGURE 2.

APPARENT PATH OF EROS.
December 1, 1930, to May 1, 1931.

sixth of the distance of the Sun. Figure 1 illustrates the relative position of the earth and Eros about this critical time. The line ☊ ☋ indicates the node or intersection of the orbit of Eros with that of the earth. The upper half is above this plane on account of the inclination, the lower part is below the ecliptic; this shows when the planet seen from the earth is situated above or below the ecliptic. The dotted line ω - ω indicates the major axis of the asteroid's orbit, the nearer end of which will be passed January 17, 1931. Because of the small distance of the two bodies the relatively small inclination of the orbit will produce rapid changes in the declination to the amount of more than one degree a day at the end of January.

Figure 2 gives an illustration of the apparent path described by Eros at this opposition. After a slow course through Auriga and Lynx in October and November the path curves southward in December so that the equator is passed on January 27, in Sextans. The southerly motion continues until the middle of March when the planet-

oid comes to a stationary point at —26°. Afterwards the declination remains below 20° south so that the best conditions of visibility for the northern hemisphere come in January. As far as the determination of the parallax is concerned the most favorable time is the end of January. A great deal of preliminary work has already been done in view of this opportunity. Since 1925 several observatories have made careful determinations of the position of the necessary comparison stars. A list of 419 such stars prepared by the *Rechen-Institut* of Berlin, has been investigated before hand not only for position but also their brightness, their spectrum, and their color index have been the subject of careful studies. These stars form a first network of reference points which is indispensable for accurate determination of position no matter what method is used. Photographic methods with long focus telescopes will of course yield better results than visual measures. But there are various delicate questions involved: the difference in magnitude between the asteroid, whose brightness may correspond to that of a 7th magnitude star, and the necessarily fainter reference stars, will require special precautions owing mainly to atmospheric dispersion and to the rapid motion of the planet. In this connection there have recently been lively discussions and various recommendations for using the opportunity to the best advantage.

It has been pointed out that while many observers will concentrate their efforts on the period of nearest approach to the earth, valuable information can be obtained by following the planet over a longer interval of time for indirect determinations of the solar parallax. The perturbations that the earth produces in the motion of Eros afford the best method of determining the mass of the earth and moon. The motion of the earth around the center of gravity of the system that it makes with the moon produces apparent shifts in the position of Eros with a period corresponding to that of the moon revolution and if carefully determined over several lunations this shift gives just as reliable a measure of the solar parallax as the direct trigonometric determinations either by measuring the diurnal parallax at one station or by combining simultaneous measures between two distant stations. Hence numerous observations covering the whole period of visibility will be made.

But aside from the usefulness of the near approach of Eros for improving the values of some of the astronomical constants the study of this planetoid itself is of physical interest. As early as 1901 appreciable variations in brightness, taking place within a few hours, were noticed. These were independent of the changes in brightness resulting from varying distances and phase-angles, the effect of which is quite large in this case. In 1901 the changes in brightness amounted to more than one magnitude in a period of $5^h\,16^m$, during which there were two unequal maxima and minima. In 1903 the variation was much smaller, while in 1907 and 1914 there were no or at least only small fluctuations. But in 1919 the amplitude of the change was again larger than one magni-

tude. It will be interesting to watch the brightness at the present favorable occasion. Already large variations are reported. Possibly the true interpretation of the change in brightness will be found. That they have something to do with axial rotation and unequal distribution of light on this small planet is unquestionable. From reasonable assumptions about the albedo or reflective power of its surface the diameter of this asteroid would be only 15 miles. It would be of interest to try the interferometer method for getting a direct measure of this quantity, but deviations from a spherical shape might well exist in this lilliputian world.

In *Astronomische Nachrichten,* No. 5743, G. Witt gives a detailed ephemeris for the asteroid in December, from which we extract the following data:

1930 0^h U.T.	(1930.0) α h m s	(1930.0) δ ° ′	Dist. to earth in million miles	Mag.
Dec. 0	9 9 39	+43 56.7	33	8.8
4	22 20	42 39.9	31	8.6
8	34 11	41 10.5	29	8.4
12	45 6	39 27.8	28	8.3
16	9 55 0	37 31.0	26	8.2
20	10 3 48	35 19.2	25	8.0
24	11 26	32 51.5	23	7.9
28	17 52	30 6.6	22	7.7
32	10 23 4	+27 3.6	21	7.6

The predicted magnitude is of course an average value in which the periodic change is not included. The maximum at opposition (7.1) is such that the object is just below naked eye visibility although the periodic variations perhaps may bring it sometimes within that limit.

THE EQUATION OF TIME

By CAROLINE E. FURNESS and IRMA J. COURTICE.

Diagrams and graphs are valuable aids to instruction in astronomy and students like to construct them independently whenever they have suitable data at hand. One of the most interesting graphs is that which shows the equation of time and its two components, as given by Young in his *Manual of Astronomy,* p. 155, and reproduced in many other textbooks. The equation of time can easily be plotted from its daily values which are published in the *American Ephemeris* in the Tables of the Sun, but the two components are not given there nor in any other place easily accessible to beginning students. They have been worked out in the astronomy department at Vassar College this year and are given here with the hope that they may be of use to students elsewhere. It should be understood at the start, however, that the method employed gives only approximate results and is intended merely to show the forms

of the curves and to illustrate the underlying causes of the equation of time which in practice is obtained by an entirely different method.

The equation of time is the difference between the mean solar time and the apparent solar time at any moment, in the sense mean time minus apparent time. It is also equal to the right ascension of the true sun minus the right ascension of the mean sun, where the true sun moves irregularly along the ecliptic in accordance with Kepler's law of areas, and the mean or clock sun moves regularly along the equator. It arises from two causes, the eccentricity of the earth's orbit and the obliquity of the ecliptic, which are explained separately and usually in the order named.

In discussing the first cause it is customary to assume an intermediate fictitious sun which moves regularly along the ecliptic, sometimes called the "dynamic mean sun," and compare its motion with that of the true sun. Their difference in longitude expressed in terms of the earth's orbital motion is the difference between the true and mean anomalies, and is known as the "equation of the center." It is the angle ESM in Figure 1.

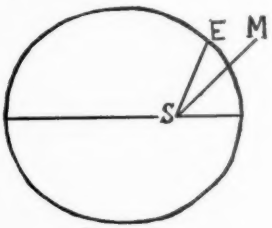


FIGURE 1.

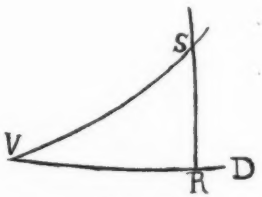


FIGURE 2.

The two suns start together at perihelion and come together again at aphelion, but during the interval the true sun moves east faster than the mean sun, its right ascension is greater and the equation of time is therefore positive. From aphelion to perihelion, the reverse is true.

However, the equation of the center is measured along the ecliptic, while difference in time is counted along the equator, hence it must be projected onto the equator and converted into difference in right ascension. This can be done by the use of the following formula, where the usual notation is used for the coördinates of the sun:

$$d\alpha/dt = \tan i \sec^2 \delta \cdot d\lambda/dt. \qquad (1)$$

Numerical values for the equation of the center are to be found in Newcomb's Tables of the Sun, *Publications of the American Ephemeris*, Vol. VI, Part I, Table XVII, which is entitled "Equation of the Center for 1900." The argument of this table is M, where M is the number of days past perihelion plus a constant 5.37. Therefore in taking the values from the table, the argument $M - 5.37$ was used for every ten days from perihelion to perihelion. They were then converted into dif-

ferences of right ascension by formula (1). The following table contains these values, which, when plotted, form the familiar curve due to the eccentricity cause. Perihelion in 1900 occurred on January 1 at 19 hours Greenwich M. T. The obliquity of the ecliptic was 23° 27′ 8″.26. The values of δ were taken from the *Almanac* for the day of the year.

TABLE I.

Days Past P.	Eq. Cen. ′	Eq. Time m	Days Past P.	Eq. Cen. ′	Eq. Time m
0	+ 1.00	+0.04	190	— 14.27	—1.01
10	20.13	1.43	200	33.24	2.32
20	39.62	2.74	210	51.28	3.49
30	57.88	3.62	220	67.90	4.48
40	74.34	4.83	230	82.61	5.56
50	87.19	5.52	240	94.98	5.97
60	99.92	6.20	250	104.65	6.46
70	108.31	6.64	260	111.30	6.81
80	113.44	6.94	270	114.72	7.03
90	115.17	7.09	280	114.78	7.10
100	113.51	7.10	290	111.42	7.02
110	108.54	6.95	300	104.73	6.77
120	100.42	6.60	310	94.86	6.31
130	89.43	6.05	320	82.10	5.63
140	75.90	5.28	330	66.80	4.71
150	60.23	4.28	340	49.42	3.60
160	42.88	3.09	350	30.50	2.22
170	24.33	1.77	360	— 10.63	—0.77
180	+ 5.10	+0.37	365¼	0.00	0.00

To obtain the effect of the obliquity cause we compare the eastward motion of the dynamic mean sun moving regularly along the ecliptic with that of the clock sun moving regularly along the equator. Their relation is shown in Figure 2, where V is the vernal equinox, S the dynamic mean sun (the true sun in this case), and D the clock sun, VS and VD being equal. SR is the hour circle of S by means of which it is projected onto the equator, VS is its longitude, VR its right ascension, and DR the equation of time resulting from this cause. It is easily seen that from equinox to solstice VD is greater than VR and the equation of time is negative, while from solstice to equinox the reverse is true.

The formula for finding VR is

$$\tan \alpha = \cos i \tan \lambda, \qquad (2)$$

This quantity was computed for every ten days from the vernal equinox to the autumnal equinox. Its values for the second half of the year repeat those for the first half, since by this method the equinoxes and solstices divide the year into four equal parts, which is not rigorously true. The steps in the process were first to find the longitude from the mean daily motion of the sun, which is 360°/365.25 or 0°.98562. Then by applying equation (2) the corresponding values of the differences right ascension minus longitude were computed.

TABLE II.

Date		Days Past Eq.	Long. ⊙	Eq. Time	Date	
d	h		° ′	m	d	h
Mar. 20	13	0	0 0.0	0.0	Sept. 19	4
30	13	10	9 51.4	—3.2	29	4
April 9	13	20	19 42.7	6.1	Oct. 9	4
19	13	30	29 34.1	8.3	19	4
29	13	40	39 25.5	9.6	29	4
May 9	13	50	49 16.9	9.8	Nov. 8	4
19	13	60	59 8.2	8.9	18	4
29	13	70	68 59.6	6.8	28	4
June 8	13	80	78 51.0	3.9	Dec. 8	4
18	13	90	88 42.3	—0.5	18	4
19	20	91.31	89 59.8	0.0	19	11
28	13	100	98 33.7	+3.0	28	4
July 8	13	110	108 25.1	6.1	Jan. 6	22
18	13	120	118 16.4	8.4	16	22
28	13	130	128 7.8	9.7	26	22
Aug. 7	13	140	137 59.2	9.8	Feb. 5	22
17	13	150	147 50.6	8.7	15	22
27	13	160	157 42.0	6.7	25	22
Sept. 6	13	170	167 33.3	4.0	Mar. 7	22
16	13	180	177 24.7	+0.9	17	22
19	4	182.62	180 0.0	0.0	20	13

These two curves do not have their origins at the same point on the time scale, since one begins at the perihelion passage and the other at the vernal equinox, hence in order to plot them on the same diagram it is necessary to find the interval in days between them. Both of these dates are given in the *Ephemeris* in the table of Planetary Configurations. That for perihelion passage has already been noted. That of the equinox is March $20^d\ 13^h$ G.M.T., making the interval between the two 77 days 18 hours.

It is interesting to note how the maximum values of the equation of time can be computed. For the obliquity cause, by using equation (2) we obtain first

$$\frac{1-\tan\alpha/\tan\lambda}{1+\tan\alpha/\tan\lambda}=\frac{1-\cos i}{1+\cos i},$$

and then

$$\sin(\alpha-\lambda)=\tan^2\tfrac{1}{2}i\sin(\alpha+\lambda). \qquad (3)$$

The maximum values for this occur when $\sin(\alpha+\lambda)=\pm1$, in which case $\alpha+\lambda=90°$, $\alpha-\lambda=2°\ 28'$ or 9.9 minutes, $\alpha=46°\ 14'$, and $\lambda=43°\ 46'$. The maximum values in the other quadrants can be found in a similar manner. The dates of their occurrence can be found in the *Ephemeris*.

The same results can be obtained by using equation (1). If $\alpha-\lambda$ is to be a maximum then $d\alpha/dt-d\lambda/dt=0$, and we have $\cos^2\delta=\cos i$, $\delta=16°\ 42'$.

The maximum value of the equation of time due to the eccentricity cause is not so easily obtained mathematically. The equation of the center can be expressed as a series of the functions of multiples of the mean anomaly nt, thus:

$$\text{eq. center} = 2e \sin nt + 5/4\, e^2 \sin 2nt + \&c$$

which can not be solved directly for a maximum. Its value can best be taken from Newcomb's Tables where it is 1° 55′ 10″.52. This occurs near the equinox where δ is near zero, and the resulting value of the equation of time from this cause is 7 min.

As already stated, the equation of time as published in the *Almanac* is not obtained by this method, and its values, if plotted are likely to agree only approximately with the graph just described. This is due in part to the fact that no account has been taken of the various perturbations produced by the moon and planets on the orbital motion of the earth which show themselves in the coördinates of the sun, nor is allowance made for precession, nutation, and annual aberration. However, neglecting the corrections, the above methods show theoretically the two causes of the equation of time and the forms of their curves.

A more complete discussion of this problem from the point of view of spherical astronomy can be found in *Godfray's Astronomy* or *Ball's Spherical Astronomy*.

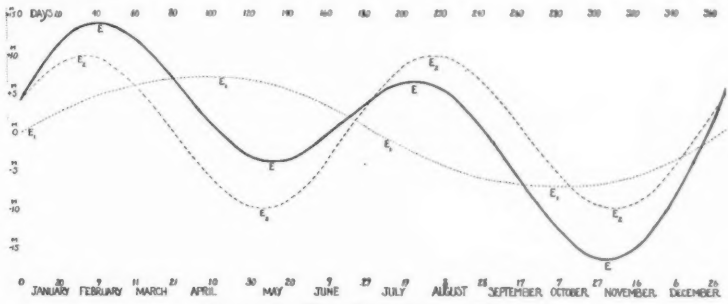


FIGURE 3. THE EQUATION OF TIME.

The graph in Figure 3 represents the equation of time and its two components obtained by plotting the values contained in Tables I and II. E_1 is the curve due to the eccentricity cause, E_2 that due to the obliquity cause, and E the resulting equation of time.

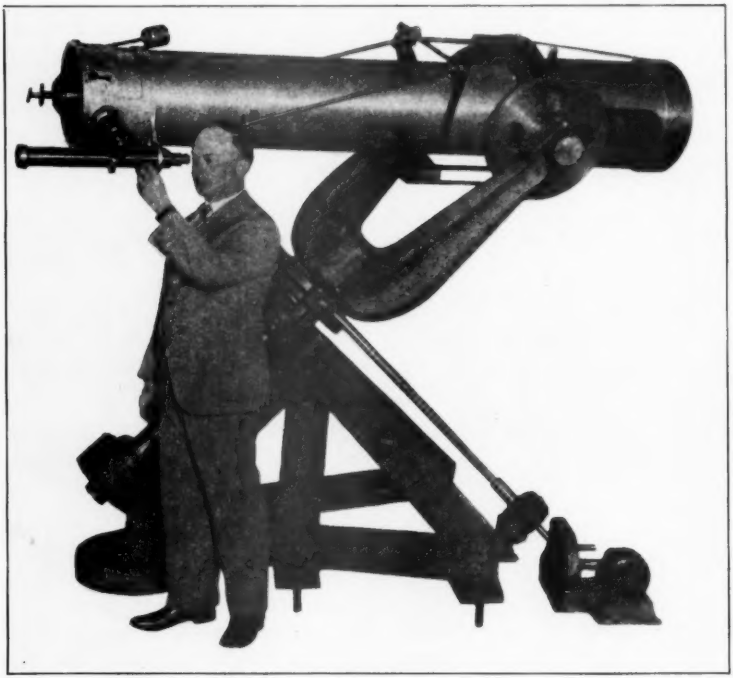
VASSAR COLLEGE OBSERVATORY, POUGHKEEPSIE, N. Y.

A TWELVE-INCH AMATEUR TELESCOPE

By R. C. PATTON.

The telescope shown in the illustration has a clear aperture of 12 inches and a focus of about 8 feet. The mounting is of the English fork type, inherently balanced without counterweights. A tapered cylindrical aluminum casting, threaded inside throughout its length to break up light reflection, forms the main tube, and is forced into the short cast iron barrel which acts as the lower end of the tube. This barrel is also threaded inside, so that no part of the interior presents a reflecting surface. The cast iron fork is a tight forced fit on the end of the polar axis, made of chrome vanadium steel, heat treated and ground to exact size.

The principal mirror is about 12¼ inches outside diameter, and about 2 inches thick, weighing twenty pounds. It is mounted in a revolvable cell, with three sets of push and pull screws for adjustment. The revolving feature was devised so that true axial alignment of the mirror



A Twelve-inch Reflector.

can be determined readily. The sky end of the tube has a cast aluminum revolving head, carrying eyepiece and finder, to insure comfortable position for the observer, regardless of the altitude of the object being observed. The finder is of 2 inches aperture and 20 inches focus. Five eyepieces are provided, which can be interchangeably mounted in the finder or main telescope. In the latter they give magnifications varying from 64 diameters to 500.

The mounting is supplied with finely divided circles, clamps and slow motions for both declination and right ascension motions. The principal right ascension dial is rotated continuously during observation by means of a synchronous induction motor, which drives it through three sets of worm reduction units, having a combined ratio of more than 2½ million to 1. A fine creeping adjustment, manually operated, is provided between the positively driven dial and the polar axis, so that very accurate adjustment can be had during visual guiding for photographic purposes. After the main right ascension dial has been set and put in motion, any other setting in right ascension can be made over a period of several hours by direct use of the pointer playing over this dial. It is unnecessary to make any time calculations with this arrangement, in order to secure a right ascension setting. In using synchronous motor drive for a telescope, it is necessary to interpose a pair of meshed gears having 365 and 366 teeth, in order to change mean solar time into sidereal time. These have helical teeth to reduce vibration.

The frame carrying the main tube is provided with two precision spirit levels for zenith setting. The declination axis and the polar axis run in eight ball bearings, which are protected from dust by felt washers within brass guards, and all gearing is totally enclosed and runs in grease.

The base and fork of the telescope are finished with black Duco, and the tube is dull grey. The eyepiece fittings and finder are lacquered brass. The approximate weight of the principal parts are: base 1060 pounds; fork 410 pounds; polar axis shaft 104 pounds; assembled tube in ring with trunnions, mirror, cell, finder, etc., 492 pounds; the total weight being a little over a ton. The rigidity of the instrument is remarkable.

The telescope is housed in a sliding roof observatory 15 feet x 18 feet, which is placed on top the flat roof of the Patton-MacGuyer Company's factory. The telescope base rests on the top of a skeleton steel tower, which at the bottom is embedded in 8 feet of concrete and passes up through the factory without touching the building or roof at any point. In fact, there is a hole cut in the factory roof, through which the top of the tower projects. The crack between the tower and the roof is about 2 inches wide all around, and is closed only by strips of felt, placed there to keep air currents from the large building from passing into the observatory.

The observatory is reached by an iron ladder from the building be-

TELESCOPE HOUSE WITH ROOF REMOVED.

low, but has a door leading out on to the roof, and four windows. One of the windows is placed in line with the telescope when the latter is horizontal, so that certain adjustments can be made by sighting a distant building through the open window, without waiting for darkness and without taking the roof off.

The roof weighs about 2600 pounds, and is mounted on 10 ball bearing wheels which travel on the edges of two steel angle beams. This track for the roof is shown plainly in the illustration. There are two coarse pitch racks attached to the under side of the roof. These are engaged by pinions on a jack shaft, which is, in turn, driven by chain and sprockets from a motor actuated worm gear unit on the floor. The motor is rated at ¼ h.p., and was made reversible by adding a lever arrangement to shift the brushes. This small motor runs the roof entirely off the building in one minute. The telescope may be directed at an object within 15 degrees of the horizon without having the roof interfere with the line of vision. This is low enough for observation near a city where the seeing at low angles is none too good.

Although the roof was strongly braced, it became necessary to add four steel cross members to tie the sides together, as it was found that a heavy load of snow tended to flatten out its pyramidal shape sufficiently to make the flanged wheels bind on the track.

During the construction of the telescope and observatory, a large number of drawings and patterns were made, which the writer of this article would be glad to lend to anyone contemplating such an undertaking.

The telescope was designed and constructed by Ralph C. Patton, of Providence, Rhode Island, and its building covered a period of about two years. The mirrors were furnished by Mr. Wilbur Perry, of Springfield, Vermont.

PROVIDENCE, RHODE ISLAND.

METEOR SHOWERS IN RUSSIAN CHRONICLES*

By D. SVIATSKY.

The first notice on shooting stars in Russian chronicles is seemingly borrowed from Byzantine sources of the reign of Justinian the First (527-565), and is as follows:

"There was at the time of Justinian the star-streaming from the evening until early morning, and everybody thought, the stars really are falling from the sky."

Chinese chronicles do not mention any meteor shower at this time; possibly therefore this Russian chronicle speaks of a shower hitherto unknown.

Later on in the same (Lavrentiev) chronicle is entered the following:

"At the time of Constantine the Iconoclast, son of Leon, there was star-streaming in the sky, the stars were falling on the earth, and all the people thought it was the Judgement Day."

Chinese chronicles mention the meteor shower of 764 December 30, just at the time of Constantine the Iconoclast (741-775).

The first original Russian observations of shooting stars were entered in our chronicles by the thirteenth century. The same Lavrentiev chronicle, 1202, speaks of the aurora borealis, and goes on:

"Some people have seen the stars streaming on the sky, and the stars falling on the earth; and the spectators anticipated the last day."

The same description of aurora is given in the Tvjer chronicle, dated February 16; it is followed by the description of the meteor shower. The investigation of all available descriptions of these phenomena has given me the impression that these two phenomena did not happen on the same night. We can therefore suppose that the Leonid shower of 1202 October 18 was described, the same mentioned by H. A. Newton in his "Descriptive Astronomy."

The nineteenth century Russian historian Karamsin mentioned the meteor shower of the fall of 1385, basing on a Russian chronicle which was lost afterwards. It is therefore difficult to say how real was his identification, the more as the description of the shower was rather symbolical.

Various chronicles (Voskressenskaja, Nikonovskaja) described the meteor shower of 1479, thus:

"Across the river Oka and in the Olexinsky places (at present Tula governmental district) at 11 o'clock at night several people saw the stars falling from the sky like a shower—the stars dropped on the earth, producing sparks, and became invisible."

*This paper by Sviatsky contains data on meteor showers which have hitherto appeared in English only in abstract. The translation is due to Professor B. P. Gerasimovič. W. J. Fisher, Harvard Observatory.

Unfortunately, this phenomenon is entered in one chronicle as of March 30, but in another as of September 21. A critical analysis of the material leads me to think that here, instead of September, October 21 is to be read, and that the March date was entered later by an evident error. We can therefore hold that here the Leonids were mentioned; though we cannot find this year on Newton's list.

In the third Novgorod chronicle, under 1505 there is given an account of a miracle, which was seen by a ponomar (a clergyman of minor rank) named Tarassij, from the belfry of his church. He saw " . . . . . a large number of angels shooting from the sky with firelike arrows, these arrows being like a shower from the clouds."

According to our ethnographist, Professor D. Zelenin, up to the present time, in the popular conception, the shooting stars are considered as the shine of the picks, with which the angels fight the demons who are trying to conquer the heavens. It is quite possible that the ponomar could believe the meteor shower to be the shine of celestial picks.

Under 1533 the Nikon chronicle mentions an undoubted Leonid shower, and dates it correctly, October 24:

"On the twenty-fourth of October, on Friday night, several people in Moscow saw the stars, which were flying like threads from the East to the Winter West." (*Winter West* means southwest.)

Here even the radiant is indicated; flying from east to southwest. Leo rises in October in the east at midnight. According to Newton, Klein, and others, the Leonids were observed in 1533 on October 24. This happened just before the death of Grand Duke Basil (mentioned in another chronicle as then sick), and, according to the superstitions of that time, would indicate the approaching death of Basil, who died the same year, 1533.

All these quotations have been critically analysed by me in my book, "Astronomical Phenomena in Russian Chronicles," (Russian Academy of Sciences, 1915). Besides, I have found, in one of the manuscripts in the Leningrad Public Library, (Pogodin's Collection, No. 1952), another curious description of a meteor shower in the fall of 1597:

"Just before the death of Tsar Feodor the stars were falling from the sky like a rain."

Tsar Feodor Ioanovich died 1598 January 6. Possibly here a meteor shower of the preceding year was meant; which may have been Leonids. (According to Newton, the Leonids were observed later, in 1602.)

The shower on the night of 1832 October 31 (November 12) was observed especially completely in Russia. A short note in the "Academical Almanac" for 1834 gives the following description:

"On the night of October 31 there were observed, at Riga, Warsaw, Odessa, Orenburg, and Oufa, brilliant aerial phenomena; polar aurora, fireballs and shooting stars."

A certain Dmitrjukov, a teacher from Sudja (Kursk district) observed the meteor shower of 1832 from 2:00 to 8:00 o'clock in the

morning. His description was published in the magazine "Moscow Telegraph," 1832, No. 17. At 5:00 o'clock he observed that:

"The lowest part of the horizon was belted by a pale whitish cloud, partly red and firelike; it seemed as if the dawn were coming. The rest of the sky was dark blue, and meteors were appearing bright and starlike, flying in various directions like shooting stars or rockets."

I think the most important thing in this description is the auroral ring observed that night, which indicates a general luminescence of the atmosphere, caused by the enormous number of meteors. Very probably the "polar aurora" (mentioned by the *Academical Almanac*) was nothing else than this luminescence. It is important to note that luminous "silverlike" clouds were observed on the night of the fall of the famous Tungus meteorite (1908 June 30), for which at the present time Mr. L. Kulik is searching.

The meteor shower of 1832 was also described by our amateur astronomer Feodor Semenov, in Kursk. This description was published in the "Moscow Telegraph," 1832, No. 15:

"In the night of 1832 October 31 I saw the natural fireworks all over the entirely clear sky. There started to appear in the different places of the sky the flying fires known as shooting stars, which superstitious people say are demons or serpents, strolling over the sky for love adventures. They increased in numbers, and finally at midnight all the sky was covered by the intermittent shower of rockets large and small. These rockets were flying in various directions, and it was as bright as if there were permanent lightning. With short intermissions this phenomenon continued from 11 o'clock to the dawn; I think it continued even later, but was not seen, owing to the light of the rising sun. I did not hear any noise or sounds. I think the Biela comet was the cause of this phenomenon, for it was known from calculations that it must pass very near the earth at this time. Maybe this phenomenon was produced by the different signs of the electric charges of the earth and the comet."

Nobody at that time noticed this deep conclusion of Semenov. But at the present time we must be surprised by this bold hypothesis of a connection between a meteor shower and Biela's comet, formulated by Semenov, being evidently impressed by his own experiments on electric phenomena. Though the meteor shower of 1832 had no connection with Biela's comet, which passed through perihelion 1832 November 27 (Gregorian style), yet Semenov's note was essentially a real prophecy, relating to a comet which really did disintegrate into a swarm of meteors during the later perihelion passage in 1872, after Semenov's death. But in this note, with acute perspicacity, Semenov anticipated the modern theory, and no longer considered a meteor shower as an atmospheric phenomenon.

As to the Armenian chronicles, which I have as yet studied only insufficiently, I can now indicate only two facts.

It is said in Arivaneti's chronicle, under 764, "And it was the shine of stars."

This is probably a quotation from the same Byzantine chronicle, on the shower of 764 December 30, made also by the Russian chroniclers.

Under 1070: "The stars were flying and falling on the earth."

But the year must be substantiated, for Armenian chronology is very complicated.

LENINGRAD, RUSSIA.

ASTRONOMICAL MODELS IN THE SOUTH KENSINGTON MUSEUM

By MARJORIE B. LEAVENS.

What teacher of astronomy does not long for models, and yet more models, to picture the sizes, distances, and movements of the heavenly bodies, involving at least three dimensions, to minds able to grasp only two dimensions from a flat drawing! Fortunate are the youth of London and others who have access to the models in the Astronomy Wing of the Science Museum at South Kensington. Having had the happy experience of seeing them recently I venture to describe several of them in detail in case others may find them suggestive, and also to call them to the attention of those who are going abroad.

I. THE SOLAR SYSTEM. These models are simple, but have the advantage over orreries and planetaria in giving a more accurate idea of relative sizes and distances, and of the great extent of the universe. In use with an orrery to show movements they would make an ideal combination.

The earth, moon, and planets are represented by tiny balls of the proper relative sizes, each swinging from a curved wire set in individual round wooden blocks. The scale used is 1 : 4,000,000,000. The sun, represented by a lighted translucent electric globe, about 14 inches in diameter, hangs from the ceiling 41 yards away from the case containing the earth (a ball of about one-eighth of an inch in diameter). Mercury and Venus are in glass cases at their correct relative distances from the sun. The exterior planets are in the case with the earth, and the approximate distances of their orbits, on the same scale, are shown by red concentric circles on a map of the neighborhood about the Museum. A note states that Proxima Centauri would lie 6,000 miles away.

II. A SOLAR ECLIPSE. The conditions of a solar eclipse can be examined by the observer thus: a model of the moon like those of the planets, but on a scale seven times as large, stands on a shelf just inside the glass case containing the model of the earth. A bar of wood on a level with the moon extends across the end of the case on the side away from the "sun." This bar is screwed to the upright frame of the

case. In the middle of it there is a sliding wooden shutter 7½ inches by 1¼ inches, in the center of which is a ¾-inch circle of bone or celluloid with a pin-hole center. As the moon stands directly within, at convenient eye-height, the observer can make his own eclipse, by sliding the shutter in its horizontal wooden track, an inch or two, with the aid of convenient wooden knobs on the shutter, for the moon is silhouetted against the electric globe sun in the distance. The sizes and distances of the models make the angular diameter of the sun when viewed through the pin-hole equal the angular diameter of the moon seen from the same spot, which would represent a point on the earth in the path of totality. By varying the position of the moon the conditions of an annular or partial eclipse could be illustrated.

III. Halley's Comet. One model shows the position of Halley's comet with respect to the sun and the earth from August, 1909, to May, 1911. The scale used for the orbits is 1 to 1,000,000,000,000, but the sun and the earth on this scale would be so tiny that they are shown by spheres over an inch in diameter. The sun, gilded, is raised on a wire pillar near the center of the earth's orbit, which is represented by a heavy enamelled wire, on which are strung spheres representing the earth at four different seasons. This orbit and that of the comet, shown by a similar wire, but shaped like one end of an ellipse, are raised on wire supports above the rectangular wooden base (38 inches by 33 inches); the former is parallel to the base, 10 inches above it, the latter placed in the proper relative position, is held at the correct inclination by pillars at intervals. The comet, at several positions along this orbit, is illustrated by cotton wound on fine wire in such a way as to show the varying size of the tail and its pointing away from the sun. White lettering marks the black base with the following: At the outer edge are the signs of the zodiac, to show where the comet, seen from the earth, would lie among the stars; directly below the wire orbits are dates by months and years, to show the location of the earth and the comet at any time, also arrows to show the direction of motion. The ascending and descending nodes, perigee, and perihelion, and the positions of the comet at its first and last observations, are marked. There is also a scale of miles from 0 to 400 million.

Among other points this model shows:

1. The relative positions of the comet, the sun, and the earth, at different dates.
2. The constellation in or near which the comet was seen during its course.
3. The length of the comet's tail, increasing as it approached the sun, decreasing as it receded.
4. The velocity of the comet, increasing as it approached the sun, decreasing as it receded.
5. The direction of the tail, always away from the sun.
6. The ellipticity of the orbit of the comet.

7. The opposite directions in which the comet and the earth move about the sun.

8. The inclination of the plane of the comet's orbit to the plane of the ecliptic.

9. The positions of the comet and the earth when the former was nearest the sun.

10. The positions of the comet and the earth when the comet was nearest the earth.

There are also notes as to the exact distances and dates at perihelion and perigee, and historical notes about Halley and the comet, with references to its appearance in the Bayeux tapestry.

IV. Orbit of Jupiter's Eighth Satellite. This model is on the scale 1 inch equal to 1,160,000 miles. The orbits of the Satellites VI and VII as well as the inner ones are represented by wires, supported by wire pillars, so that the planes are at the correct inclination to the horizontal circular base which represents the plane of the earth's equator in 1910. Pillars are placed at Jovi-centric R.A. 0, 3, 6, 9, . . . 21 hours. The path of the eighth satellite which is retrograde is indicated by an outer wire which is colored differently for each of the years from January 20, 1908, through January 1, 1914. Discs supporting the wire give dates when the satellite is passing through the points indicated. The positions at oppositions in 1908, 1909, and 1910, are marked by white bands on the wire. Additional notes of interest are given.

V. Pons-Winnecke Comet. A simple, yet effective model shows the orbit of the Pons-Winnecke comet with relation to that of the earth. The scale used is 1 : 1,000,000,000,000, and the elements are the ones given by Dr. Crommelin in the *Journal of the British Astronomical Association*, February and March, 1927.

A white cardboard disk 12 inches in diameter represents the plane of the earth's orbit and lies horizontally. The comet's orbit, represented by a copper wire, is properly inclined and fastened to this at the point of the descending node. The disk is slightly raised on a small wooden pillar to allow the wire to clear the table top. The disk of the earth's orbit is marked by months except for the three months near perigee, when intervals of three days are indicated.

In addition to the models described there are excellent exhibits of apparatus and instruments of all kinds from the most primitive to modern types. There are celestial globes, optical instruments, telescopes, models, photographs and diagrams of mountings, spectroscopes, compasses, micrometers, quadrants and astrolabes, sun dials, water clocks, and other time instruments, models of masonry used for observing at Jaipur, India, and others from other countries, transparencies and photographs of recent observations, and a section of apparatus and information relative to meteorology. Foucault's gyroscope and terrestrial globe with mounted apparatus show the behaviour of the pendulum at any latitude. Another apparatus demonstrates and records gravitation-

al effects. The large well-arranged building has many other objects of interest to scientists.

202 Broadway, Norwich, Connecticut.

FORTY-FOURTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY

(Continued from page 522.)

ABSTRACTS OF PAPERS

SOLAR VARIATION AND TEMPERATURE CHANGES.

By C. G. Abbot.

Author showed by five slides: (a) That 189 sequences of solar variation ranging from 0.5 to 2.0 per cent (averaging 0.8 per cent in amplitude and 5 days in progress from trough to crest or vice versa) had appeared in the Montezuma observations of the Smithsonian Institution since January 1, 1924.

(b) That, for example, in 9 cases of rising sequences occurring in March, 7 had agreed in showing a simultaneous rising sequence of Washington mean temperatures; while (c) in 10 cases of falling sequences, 8 had agreed in showing simultaneously falling temperatures.

(d) The similar behavior of March and May in these respects, but opposite behavior of July and October were shown.

(e) The progress of this apparent reversal of sign of the correlation throughout the year was shown. Other United States stations exhibit similar but not identical correlations.

Author suggested that, since reversals occurred, the effect is not a direct one, but probably involves some atmospheric mechanism. The average results (some 5° F change at Washington accompanying 1 per cent change in the sun) are so large that if the correlation becomes better understood it may serve to advance long-range weather forecasting.

A STUDY OF THE HYDROGEN LINES OF STARS IN TWO GALACTIC CLUSTERS.

By Carol Jane Anger.

Hydrogen lines in stars of Messier 7 and the Pleiades have been studied with the primary object of finding an absolute magnitude criterion for A-type stars. The three principal findings are:

1. Within the errors of measurement on these objective prism plates, there are no systematic differences of contour in A-type stars and, in particular, no "Stark contour."

2. There is a simple relation between total absorption and absolute magnitude.

3. A theory connecting increase in total absorption with increase in pressure (increase of Stark effect) is given.

Accordingly the conclusion is drawn that the Stark effect causes very small, if any, differences in contour, but may explain the increase of total absorption with absolute magnitude.

HALLEY'S COMET IN 1910.

By N. T. Bobrovnikoff.

To appear as a *Publication* of the Lick Observatory.

CORRELATION BETWEEN ASTRONOMICAL AND GEOPHYSICAL PHENOMENA.

By Benjamin Boss.

THE POMONA COLLEGE ECLIPSE EXPEDITION OF APRIL 28, 1930.

By F. P. Brackett.

The chief objective of this expedition conducted by Dr. Whitney and the writer was to determine with new accuracy the location of the moon's shadow upon the earth, at a number of points, together with the corresponding times. Two quite new and entirely different methods were used.

The first method was to secure motion pictures of the shadow on the earth with sound cameras, mounted in airplanes reaching an altitude of 15,000 feet above ground, so as to include the whole shadow in each picture-frame together with ground marks selected for identification, at the same time recording upon the margin of the picture film itself the seconds-signals broadcast by The Navy Department and received by a special radio receiving set.

At two points on the predicted path, nearly 100 miles apart, ground stations and marks were set up. Over each of these a powerful airplane (one a Fairchild Army plane ordered by President Hoover and the other a trimotor Fokker secured through Colonel Lindbergh) rose to about 19,000 feet elevation, carrying camera, amplifiers, battery, radio receiving set, and expert operators and aviators.

The second method of locating the shadow-path was to measure with photometers the intensity of general radiation received at a number of points in line across the path. The milliammeters connected with each photo-electric cell and amplifier, being mounted with clocks upon a panel, were photographed with a cine-camera. The network of curves from this record shows the time-variation of light intensity at each point, and so serves to locate the edges of the shadow and the times of second and third contact at each point. Seldom does an eclipse occur which is so favorable for this purpose (with so small a shadow), and never had such a "set-up" been possible before.

With rare coöperation of expert technicians and men of influence, in spite of great difficulties, the whole program was carried out as planned.

But clouds, covering the whole region, turned the drama into tragedy and prevented the definitive results desired; although the motion picture film taken by Captain Stevens in the army plane shows dimly the dark shadow sweeping swiftly over the billowy upper surface of the clouds.

Nevertheless we believe that the results of the expedition have demonstrated, first, the value of the methods used and the entire probability of obtaining the objective if clouds had not intervened, and, second, that at some future eclipse, though less favorable, the same problem may be worked out, using both of these methods with suitable modification in the details of the technique.

DISCUSSION OF THE ANNUAL TERM IN THE RESIDUALS IN THE MOON'S LONGITUDE.

By Dirk Brouwer.

Published in *The Astronomical Journal*, No. 946.

SPECTRA OF COMPARISON STARS FOR EROS.

By Annie J. Cannon.

The spectra of the Kopff comparison stars for Eros, not contained in the Henry Draper Catalogue, were published in *Harvard Bulletin* 871, December, 1929. Later, at the request of Dr. H. Spencer Jones, a search was made for the spectra of stars to the eleventh magnitude within one half of a degree on each side of the path of Eros. About 1700 spectra were thus classified or approximately determined, and marked on photographic prints covering the path of Eros from October, 1930, to May, 1931. Dr. Jones proposes to publish a list of these stars, whose spectra are of Classes B5 to A0, and K5 to M, with the hope that astronomers will exclude them when measuring Eros plates so that errors due to differential atmospheric dispersion may be avoided.

A full account of this paper will soon be given in a *Bulletin* of the Harvard College Observatory.

ASTRONOMY BY RADIO.

By O. L. Dustheimer.

Station WTAM, Cleveland, Ohio, has broadcast radio lectures on astronomy for nearly six years. This feature of WTAM has become very popular. Twenty-four talks have been given the past year.

About a year ago, "The Star Gazer's Club" program was introduced over WTAM. Special maps giving the constellations visible each month with a discussion of these star groups were sent to members by Baldwin-Wallace College and the Station. The Club now has more than 3500 members located in 35 states and several Canadian Provinces. Thous-

ands of letters have been received from the radio audiences showing their keen appreciation of popular astronomy by radio.

THE CONTOURS OF HYDROGEN LINES.

By C. T. Elvey and Otto Struve.

Paper to be published in the *Astrophysical Journal.*

THE PLANETARIUM AS A COMPUTING DEVICE.

By Philip Fox.

The Planetarium may be used for rapid approximate solution of various problems of practical astronomy, transformation of coördinates, etc. The method of procedure illustrated at the instrument is too obvious to require explanation and in any case offers but slight advantage over the procedure with the armillary sphere or the celestial globe.

There is a distinct field of usefulness, however, in the computation of such data as are listed in Ephemerides under the head of Phenomena. The gearing for the driving of the planetary projectors is so accurately devised that once the projectors are set the planets move and maintain their positions with respect to each other and to the stars with very close approximation of their true position in the sky, and that for long intervals of time. The Planetarium may then be utilized for making the first approximations for the various planetary configurations. This was illustrated by showing the triple conjunction of Jupiter and Saturn which takes place in 1940 and 1941. The average deviation between one reading of Planetarium dates and dates computed by Professor W. H. Garrett was three days. Several repetitions of the settings should reduce the errors.

POSITIONS OF EROS COMPARISON STARS.

By J. C. Hammond.

The primary reference stars for Eros at its near approach to the earth in 1930-31 were selected by Professor A. Kopff (*A.N.*, 5375 and 5403) and are distributed uniformly along the path of the planet from October 1, 1930, to May 5, 1931, so that for every field, $2° \times 2°$ with Eros at the center, there will be at least 8 of these stars. The stars are divided into two lists, the first containing 419 stars between the declinations $+48°$ and $+20°$; the second containing 402 stars between $+20°$ and $-27°$. The magnitudes vary from 7.0 to 10.0.

Both lists have been well observed and a definitive catalogue of the positions of these stars is being prepared by Kopff from the meridian-circle observations made at the various observatories. These definitive positions should be used as a groundwork for all parallax reductions.

FLEXURE DETERMINATIONS BY THE BONSDORFF METHOD.

By J. C. Hammond, C. B. Watts, and J. E. Willis.

The method of determining flexure devised by Bonsdorff (*Bull. of the Pulkowa Observatory*, No. 66) has been applied to the 6-inch transit circle of the U. S. Naval Observatory. Apparatus consisting essentially of four light steel tubes attached rigidly to the cube and supporting a flat mirror in front of the objective was temporarily mounted on the instrument. The position of the spider lines was compared at various zenith distances with that of their reflected images formed by the mirror. The effect of small flexures in the tubes supporting the mirror was largely eliminated, as they caused the mirror to move nearly parallel to itself.

Measures of the flexure in both right ascension and zenith distance were made. The results showed no appreciable flexure in right ascension, indicating that the known variation of the observed right ascensions with the declination cannot be due to flexure of the instrument tube, including the objective and micrometer. These deviations are perhaps due to a bending of the axis of the instrument. The flexure in zenith distance was found to be free from discontinuities, and was symmetrical with respect to the zenith. It conformed approximately to the sine law of variation.

THE SPECTROSCOPIC ORBITS OF BOSS 523 AND BOSS 4876.

By W. E. Harper.

Boss 523. This star was discovered to be a spectroscopic binary by the author in 1922. Since that time to the present 42 measurable spectrograms have been secured. In 1927, when 30 had been secured, preliminary work suggested that in addition to the main period of 93.50 days there was a longer one of about two years with a semi-amplitude of velocity variation of nearly 10 km/sec for this larger orbit. Publication was withheld and 12 additional plates have since been secured and the whole series measured anew. The trend of the residuals seems peculiar but as one year would suit the residuals almost equally well as the two-year period previously entertained it is preferred to consider them wholly accidental until some further investigation has been made. The eccentricity is 0.445, $\omega = 100°.95$, $\gamma = +25.75$ km/sec, $K = 19.43$ km/sec, and $T =$ J.D. 2423389.995.

Boss 4876. Twenty-three spectrograms of this star, of photographic magnitude 7.6 and type A3, were made with single-prism dispersion. The period is 1.54039 days and is believed correct to the fifth decimal place. Five observations in 1919 are all positive and two in 1921 are both negative yet it is deemed the period is the correct one, and the probable error of a plate of ± 4.1 km/sec is set down to accidental error. The orbit is practically circular ($e = .008$) while the semi-amplitude is 88.69 km/sec and the velocity of the system -29.79 km/sec.

PHOTOMETRIC OBSERVATIONS OF EROS.

By Margaret Harwood.

Remarkable variations in range as well as a possible change of the period of the variability of the light of Eros shows it to be an object of especial interest from a photometric standpoint. The phase coefficient varies also. The only way to solve the mysteries of this asteroid lies in obtaining a long series of systematic observations of its magnitude. From now until June, 1931, Eros will be very favorably situated for observation. It is hoped that a continuous series of photometric observations, both visual and photographic, will be made at the observatories of both the northern and southern hemispheres.

Estimates of magnitude should be made as often as every ten minutes during each period of observation. The ideal arrangement would be to have photographic and visual photometric, or photovisual, observations made simultaneously, thus studying the changes of magnitude in both blue and yellow light. Discussions of previous work on Eros and references are to be found in *Harvard Circular*, No. 269, 1924, and in the *Publications of the American Astronomical Society*, **5**, 386. Eros was photographed with the 7½-inch Cooke triplet telescope of the Maria Mitchell Observatory on July 28, 30, 31, August 1, and 27, 1930.

THE VARIABLE BRIGHT LINES OF HYDROGEN IN THE SPECTRUM OF π AQUARII.

By C. D. Higgs.

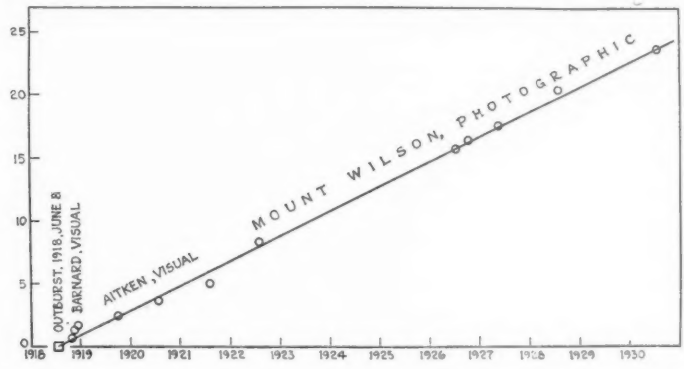
Measures of spectrograms obtained at the Yerkes Observatory have failed to substantiate the contention of the late Professor R. H. Curtiss that velocity displacements accompany the changes in the intensity ratios of the emission components of the H lines. On the evidence of the Yerkes plates it is impossible to fit any period. The influences due to effective exposures seem to cause great discrepancies throughout the series. The mean total width of the Hβ line is 7.55 A, which is in good agreement with the value of 7.42 A given by Curtiss. Particular attention is called to the very rapid change in Hβ from 1930 May 6 to 1930 August 20, which involves the almost complete disappearance of the red emission component.

THE NEBULOUS ENVELOPE AROUND NOVA AQUILAE 1918.

By Edwin P. Hubble and John C. Duncan.

The nebulous envelope around Nova Aquilae 1918, which was discovered by Barnard four months after the outburst of the star and which was discussed by the authors in *Contribution from the Mount Wilson Observatory*, No. 335 (1927), has continued to increase in diameter at a uniform rate of two seconds of arc a year and to grow fainter. The apparent diameter on July 19, 1928, was 20″.5, and on

June 30, 1930, it was 23".8. From the star's distance of 360 parsecs derived by the authors (*loc. cit.*) it appears that the present diameter of the nebula is somewhat over 8,000 astronomical units. The gases constituting the nebula are, contrary to results obtained by spectroscopic



DIAMETER OF THE NEBULOUS DISK
AROUND NOVA AQUILAE 1918

observers in 1919, evidently equally distributed throughout its extent, for slitless spectrograms made in 1926 show images of equal size in the light of three hydrogen lines, λ4686, and the bright nebular lines.

The growth of the nebula from 1918 to 1930 is shown in the figure, in which the measured apparent diameter is plotted against the time.

REPORT ON PHOTO-ELECTRIC STUDIES.

By C. M. Huffer.

The light-curves of five variable stars were shown. H.R. 7165 is a Cepheid, Boss 1607 and H.D. 25833 are eclipsing, 44 i Bootis is an ellipsoidal eclipsing, and Epsilon Aurigae is a long-period eclipsing with secondary oscillations.

The following table gives the elements of the first four stars:

Star	H.R. 7165	Boss 1607	H.D. 25833	44 i Bootis
Period, days	4.4714	9.9450	2.028715	0.26780708
$t_2 - t_1$	1.99 (M — m)	4.477	1.0582	0.1339
t_0 JD 242	5056.32 (max)	5615.491	4465.6886	6058.8554
Eccentricity		Assumed 0	Assumed 0	0
$k = r_2/r_1$		0.65	0.70	
i		87°.83	77°.71	
J_2/J_1		1.178	1.176	
m_1		0.86	5.21	
m_2		1.04	4.60	
r_1		1.92	3.68	
r_2		1.20	2.58	
d_1		0.122	0.104	
d_2		0.603	0.269	
$a = a_1 + a_2$		16,700,000 km	9,942,000 km	

Star	Boss 1607	H.D. 25833
Diff. of mag.	1.20	0.95
Amt. of eclipse	0.95	0.70
Disks assumed	Uniform	Darkened

A light-curve for 44 i Bootis was computed using the formula:

$$l = 0.9964 - 0.0382 \sin\theta - 0.0386 \cos\theta - 0.2294 \cos^2\theta$$

The bodies are ellipsoidal with small partial eclipses at the times of conjunction.

The light-curve of Epsilon Aurigae was shown to September 2. The secondary oscillations have continued after the end of the eclipse.

THE PROPOSED CALENDAR REFORM.

By Moses Jung.

A review of some of the proposed new calendars.

ANALYSIS OF THE ARC AND SPARK SPECTRA OF ZIRCONIUM.

By C. C. Kiess and Harriet K. Kiess.

The analysis of the arc and spark spectra of zirconium, of which preliminary reports were presented at the 30th and 33rd meetings of the Astronomical Society, has been carried forward to completion. The spectrum Zr I is built up on terms belonging to the singlet, triplet and quintet systems, and Zr II on terms of the doublet and quartet systems. The terms conform in all respects to those required by theory. From the series which have been found in each spectrum we derive ionization potentials of 6.5 and 14 volts, respectively, for the neutral and once ionized Zr atoms.

We may apply such an analysis to various astrophysical problems. From the terms which have been found for Zr, we may calculate all the lines which the atom can absorb or emit. Comparison of these calculated wave-lengths with lines in the sun's spectrum has led to the identification of more than 50 faint Fraunhofer lines which do not appear as emission lines in laboratory sources. The complete investigation will appear in the *Bureau of Standards Journal of Research*.

ON A REASON FOR THE APPEARANCE OF NEGATIVE PARALLAXES IN THE DETERMINATION OF THE DISTANCES OF STARS.

By O. J. Lee.

Published in *Annals of the Dearborn Observatory of Northwestern University*, Vol. IV, Part 1.

NOTE ON THE ORBIT OF EROS.

By A. O. Leuschner and H. Thiele.

OBSERVATIONS OF THE CENTRAL ECLIPSE OF APRIL 28, 1930, AT HONEY LAKE, CALIFORNIA.

By Isabel M. Lewis.

Published in *Popular Astronomy*, **38**, 455.

A SMALL PERSONAL EQUATION IN PHOTOGRAPHIC ZENITH TUBE OBSERVATIONS.

By F. B. Littell.

To be published in full in *The Astronomical Journal*.

THE ECLIPSE OF EPSILON AURIGAE.

By Dean B. McLaughlin.

During the eclipse of ϵ Aurigae in 1928 to 1930 several spectral lines showed strongly varying systematic displacements referred to the set of lines measured for velocity. Hγ and Hδ showed large positive residuals during the first half of eclipse and negative in the latter half with range of 25 km/sec; λ 4227 Ca, small negative in the first half, large negative in the second, range 16 km/sec; λ 4481 Mg II, small negative in the first half, large positive in the second, range 20 km/sec. The residual curve of this line in the second half is largely a reflection of the velocity curve from all lines (Struve and Elvey find it the only strong line not asymmetrical during eclipse); $\lambda\lambda$ 4078, 4216 Sr II shows a trend nearly opposite that of hydrogen, range 10 km/sec. The intensity ratio 4227 : 4216 showed sharp maxima just at the beginning and the end of the total phase. In 1930, January to March, three more sharp maxima occurred.

Strong variations of widths of hydrogen lines are correlated with their changing displacements. Measures of edges of lines clearly show that the largest residuals occur when lines are widest and that residuals are not due to bodily shifts of lines but to a flaring of one edge, the other edge remaining nearly in its normal position.

A strong negative shift of the plate velocities in the second half of eclipse is probably due to line asymmetries observed by Struve and Elvey. Evidently H and Ca I are most affected by this asymmetry, Sr II less affected, and Mg II only slightly or not at all. An analogy with the anomalous absorption in the spectrum of β Lyrae during eclipse is suggested. Possibly the effect is due to light of the bright star shining through an extensive atmosphere surrounding the fainter occulting body. In β Lyrae separate distinct lines are produced; in ϵ Aurigae Adams and Joy find the lines doubled.

(To be continued.)

PLANET NOTES FOR JANUARY 1931

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast from the central part of Sagittarius to the central part of Capricornus. On January 3 at 4:00 A.M., C.S.T., the sun will be at perihelion. At that time the distance from the earth to the sun will be slightly more than 91.3 million miles. The position of the sun on the first and last days of the month will be respectively: R.A. $18^h\,42^m$, Decl. $-23°\,6'$; R.A. $20^h\,50^m$, Decl. $-17°\,42'$.

The phases of the moon will occur as follows:

Full Moon	Jan.	4 at	7 A.M.	C.S.T.
Last Quarter		10 "	11 P.M.	"
New Moon		18 "	1 P.M.	"
First Quarter		26 "	6 P.M.	"

Perigee will occur on January 6 at 9:00 A.M., C.S.T., and apogee will occur January 22 at 7:00 A.M., C.S.T.

Mercury will be in eastern Sagittarius, moving with an apparent westerly motion until January 17 after which it will retrace its motion to a position somewhat south of that at the beginning of the month. At the beginning of the month its apparent position will be near that of the sun since inferior conjunction will occur on January 6, but by the end of the month it will be a morning star of about zero magnitude rising about an hour and a half before the sun. Greatest elongation west will occur on January 28. On January 16 it will be in conjunction with the moon. Its distance from the earth will vary from a minimum of about 62 million miles on January 7 to about 97 million miles at the end of the month.

Venus will be a morning star of magnitude about minus four in northern Scorpio, and during this period it will rise about three hours before the sun. During the middle of the month it will be a few degrees north of the bright star Antares. Its distance from the earth will be about 40 million miles at the beginning of the month, and by the end of the month the distance will have increased to about 60 million miles. On January 14 it will be in conjunction with the moon.

Mars will be in eastern Cancer. Opposition will occur on January 27, thus Mars will be above the horizon practically all night in the northern hemisphere. Its apparent motion among the stars will be westerly and its brightness will be about magnitude minus one. On January 6 it will be in conjunction with the moon. January 25 Mars will be nearest the earth this opposition, and its distance at that time will be about 62 million miles. At the beginning of the month its distance will be greatest by about 5 million miles.

Jupiter will be in central Gemini, and, like Mars, it will be above the horizon most of the night in the northern hemisphere since opposition will occur on January 6. Its brightness will be about minus two, and its apparent motion among the stars will be westerly. It will be in conjunction with the moon on January 4 and on January 31. At the time of opposition its distance from the earth will be about 390 million miles, but by the end of the month its distance will have increased about 11 million miles.

Saturn will be in eastern Sagittarius, and thus its apparent position will be near that of the sun. Conjunction with the sun will occur on January 5.

Uranus will be in central Pisces, and it will be in quadrature east of the sun on January 2. On January 25 it will be in conjunction with the moon. Its apparent motion will be easterly. During the middle of the month its distance from the earth will be about 1900 million miles, and at this time it will be on the meridian about 5:00 P.M.

Neptune will be in Leo near ρ Leonis. During the middle of the month it will be on the meridian about 3:00 A.M., and its distance during the middle of the month will be about 2700 million miles. Conjunction with the moon will occur January 8.

OCCULTATIONS

VISIBLE AT WASHINGTON.
[From the *American Ephemeris.*]

Date 1931	Star	Mag.	IMMERSION Washington C.T.	IMMERSION a	IMMERSION b	IMMERSION Angle E from N	EMERSION Washington C.T.	EMERSION a	EMERSION b	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Jan. 2	107 B.Aur	6.5	23 24	—2.0	0.0	83	0 44	—1.7	—0.9	271
3	49 Aur	5.1	20 19	—0.2	+3.5	34	21 4	—2.1	—1.3	315
5	4 Cnc	6.2	6 22	—0.8	—0.4	59	6 56	+0.8	—2.3	341
8	*l* Leo	5.2	0 53	—0.7	—2.5	168	1 43	—2.1	+1.7	256
24	Uranus	6.2	19 58	—1.0	0.0	57	21 10	—0.6	—0.2	238
28	36 Tau	5.6	21 50	—1.6	—3.0	125	22 44	—1.7	+2.0	210

The quantities in the columns a and b are given for the purpose of making these predictions useful for any place within 200 or 300 miles of Washington. The procedure is as follows: Subtract the longitude of Washington (77°.1) from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under a for the star to be observed; similarly, with the latitude (38°.9) using b; apply the sum of the products, with its proper sign, to the Washington C.T., and obtain the predicted Washington Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to add 8.3 minutes to Washington Civil Time.

VISIBLE AT OMAHA AND VICINITY.

Date 1931	Star	Mag.	G.C.T.	a	b	P
			h m	m	m	°
Jan. 25	Uranus	6.2	0 48	—0.9	+2.4	26
29	36 Tauri	5.6	2 11	—2.3	—0.5	101

VISIBLE AT LICK OBSERVATORY AND VICINITY.

Date 1931	Star	Mag.	G.C.T.	a	b	P
			h m	m	m	°
Jan. 3	107 B. Aurigae	6.5	3 25	—0.3	0.0	41
3	136 Tauri	4.6	12 06	—0.4	+1.1	101
28	ξ Arietis	4.8	3 47	—1.5	+4.3	16
28	τ Arietis	5.1	8 25	—0.2	+1.1	95
29	36 Tauri	5.6	1 16	—1.4	+1.8	74
30	415 B. Tauri	6.1	23 10	—0.4	—1.5	113

The approximate times for observers within 300 miles of Omaha can be found by using the constants a and b, given in the table, according to the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

$\Delta\lambda$ and $\Delta\phi$ in this case being obtained by using the longitude (96°0) and latitude (41°3) of Omaha, and subtracting these, respectively, from the longitude and latitude of the place.

For observers within 300 miles of Mount Hamilton, California, the same rule is followed using the longitude (121°7) and latitude (37°3) of Lick Observatory.

Only disappearances are given.

Wm. Cletus Doyle, S.J.

Creighton University Observatory.

VARIABLE STARS

Monthly Report of the American Association of Variable Star Observers for October, 1930

The Nineteenth Annual Meeting held at the Harvard Observatory beginning on the evening of Friday, October 17, when Miss Anne S. Young lectured before a Bond Astronomical Club Open Night on the subjects of Pluto and Eros, until late Saturday evening, when Dr. Shapley, as toastmaster at the dinner, wove in his bits of current event news, was one round of activity. The attendance was the largest for some years, the papers read and discussed were of a high calibre, and the address of Mr. A. L. Ellis, of the General Electric Plant at West Lynn, Massachusetts, dealing with the progress being made on the construction of the 200-inch mirror, was a revelation to all who were privileged to listen.

The following officers were elected for the ensuing year:

President	Alice H. Farnsworth
First Vice President	Harriet W. Bigelow
Second Vice President	G. B. Lacchini
Secretary	Wm. Tyler Olcott
Treasurer	Percy W. Witherell

Miss Leah B. Allen of Hood College, Frederick, Maryland, was elected a new member of the Council, as well as Messrs. Lacchini and Witherell.

The next meeting of the Association is to be held some time in May, 1931, at the American Museum of Natural History in New York, at the invitation of Dr. Clyde Fisher, head of the department of astronomy at that institution.

We are glad to welcome to our ranks of active observers Mr. R. C. Shinkfield, of Adelaide, South Australia; Mr. M. Huruhata, of Okaya, Japan; Miss Marian Shultz, of Montclair, New Jersey; and after a period of quietude, Messrs. Beyer of Hamburg, Germany, and Proctor of Ann Arbor, Michigan.

The report for this month reflects the revived interest in variable star observing following vacations; the number of observations received being the greatest for any single month during the past year.

The Annual Summary is one of which we may feel proud, totaling almost as many observations as during 1929, and with 15 more observers taking part in the program. We have passed the 300,000 mark in our grand total to date, and the

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

Aug. 0 = J.D. 2426189; Sept. 0 = J.D. 2426220; Oct. 0 = J.D. 2426250.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	R And	RR And	S Cas	U Per	o Cet
000339	001838	004533	011272	015254	*021403*
210 13.3 Bl	262 10.4 Gy	243[13.9 B	224 10.3 Jo	247 8.7 Hr	211 5.2 Sl
212[12.6 En	262 10.1 Fd	247[14.2 Br	230 10.7 Jo	247 8.4 Me	217 5.5 Jo
RV Cep	263 9.5 Wd	RV Cas	236 11.4 Br	248 8.6 BL	224 5.7 Jo
000773	269 9.5 Ma	004746a	238 11.0 Jo	250 8.5 Al	225 6.5 Hr
214[13.0 By	S Tuc	235[14.7 Br	238 11.3 Pt	251 8.4 Bw	228 6.6 Hr
235[12.5 By	*001862*	243[13.8 B	242 11.3 Jo	253 8.6 BL	229 6.1 Tf
S Scl	210 12.6 Bl	244[13.2 Ch	250 12.0 Bc	253 8.5 Hr	234 6.5 Ah
001032	211 12.5 Ht	W Cas	252 11.1 B	260 8.5 BL	235 6.2 Tf
210 9.5 Bl	212 12.7 En	004958	U Psc	261 8.2 Al	236 6.3 L
211 9.5 Ht	S Cet	217 11.7 Jo	011712	263 8.5 BL	238 6.6 Jo
212 9.3 En	*001909*	224 10.3 Jo	236 11.0 Br	272 9.1 Mc	239 7.0 Hr
219 9.4 Ht	230 10.5 Jo	230 9.9 Jo	237 11.3 L	S Ari	240 7.9 Hr
X And	230 10.0 L	237 10.2 BL	238 11.0 Pt	015912	240 6.8 Pt
001046	238 10.6 Pt	238 9.6 Pt	RZ Per	236 13.3 Br	241 7.1 Tf
232 12.7 Lj	238 10.3 Jo	238 9.8 Jo	012350	242 14.0 L	241 7.1 Hr
235 12.5 Br	238 10.8 Br	242 9.6 Jo	236 10.4 Br	R Ari	242 6.7 Jo
236 12.6 Lj	241 10.2 Tf	243 10.3 Bw	238 10.0 L	021024	242 7.2 Ch
238 12.5 Ch	243 10.1 Jo	243 10.2 BL	R Psc	236 12.7 Br	243 6.9 BL
243 12.8 B	244 10.7 Ch	243 10.1 B	012502	239 12.8 Pt	243 7.2 Hr
246 12.8 Lj	247 10.2 L	244 10.1 Ch	236 13.2 Br	239 12.2 L	246 7.2 Tf
250 12.9 Lj	250 10.5 Bc	246 10.3 BL	238 11.5 Pt	239 12.2 L	246 7.0 BL
T Cet	T Scl	248 10.0 BL	252[10.6 Ah	242 12.4 Ch	247 7.0 Me
001620	*002438a*	253 10.1 BL	RU And	248 12.4 Ma	247 7.0 Fd
229 6.4 Tf	212 9.0 En	260 10.0 BL	013238	W And	248 6.7 Sl
235 6.4 Tf	T Phe	263 9.9 BL	236 13.2 Br	021143a	248 7.6 Ma
239 6.6 L	*002546*	266 9.8 BL	238 13.2 L	236 10.9 Br	248 7.1 BL
241 6.1 Tf	210 13.5 Bl	U Tuc	239 13.8 Pt	239 11.4 Pt	249 7.1 Hr
246 6.6 Tf	W Scl	*005475*	244 13.0 Ch	242 11.4 Ch	252 7.1 Ah
T And	*002833*	208 10.1 Ht	248 13.1 Ma	251 11.5 Bw	253 7.2 BL
001726	210 13.0 Bl	210 9.9 Bl	269 12.3 Ma	262 12.1 Gy	253 7.5 Hr
235 14.0 Br	Y Cep	?12 10.2 En	Y And	T Per	254 7.3 Gy
244 13.8 B	003179	219 10.5 Ht	013338	021258	260 7.3 BL
T Cas	235 12.5 Br	Z Cet	236[13.9 Br	217 8.7 Jo	262 7.4 Gy
001755	239 12.4 L	*010102*	238 14.1 L	224 8.7 Jo	263 8.0 Wd
217 9.4 Jo	244 13.0 Ch	230[11.8 L	244[13.0 Ch	230 8.6 Jo	S Per
224 9.5 Jo	U Cas	239 13.9 L	247[13.9 Br	239 8.4 Jo	021558
230 9.4 Jo	004047a	U Scl	X Cas	240 8.4 Pt	217 8.5 Jo
233 9.2 Ch	235[13.9 Br	*010630*	014958	243 8.5 Jo	224 8.5 Jo
238 9.3 Jo	238[13.3 Ch	210[13.2 Bl	217 10.7 Jo	243 8.9 BL	230 8.4 Jo
238 9.1 Pt	240 14.6 L	U And	223 10.7 Jo	246 8.9 BL	239 8.3 Jo
239 8.8 L	RW And	010940	230 10.5 Jo	248 8.8 BL	240 9.2 Pt
239 9.0 Jo	004132	229[13.0 L	238 10.3 Jo	252 8.8 Ah	243 8.4 Jo
243 9.4 B	235 12.3 Br	236[13.5 Br	239 10.5 Pt	253 9.0 BL	243 9.0 BL
246 9.0 Jo	238 13.8 Pt	240 14.5 L	242 10.3 Jo	260 8.8 BL	246 9.2 Sz
247 8.2 Al	240 13.9 L	247[13.8 Br	243 11.0 Bn	260 8.4 Me	246 8.8 BL
252 9.8 Ah	V And	UZ And	262 10.6 Bn	263 8.7 BL	248 8.6 BL
262 8.2 Al	004435	011041	U Per	Z Cep	252 9.3 Ah
R And	235 10.1 Br	236[14.2 Br	015254	021281	253 9.1 BL
001838	238 9.6 Ch	247[14.2 Ma	219 8.7 Jo	236 12.1 Br	260 9.3 BL
235 12.5 Br	252 9.3 B	252[13.9 Bw	239 8.5 Pt	239 12.0 Pt	260 8.9 Me
238 11.7 Pt	X Scl	S Psc	239 8.7 Hr	244 11.5 L	263 9.3 BL
238 12.0 Ch	*004435*	011208	240 8.7 Hr	o Cet	R Cet
238 12.1 Fd	210 13.0 Bl	236 12.2 Br	241 8.8 Hr	*021403*	*022000*
243 11.5 B	RR And	242 12.2 L	242 9.3 Jo	161 3.4 Sl	217 9.6 Jo
247 11.6 Ma	004533	S Cas	243 8.8 BL	179 3.8 Sl	230 10.6 Jo
252 10.8 Ah	235[14.2 Br	011272	243 8.3 Bw	193 4.4 Sl	236 10.9 L
254 10.8 Gy	238[12.6 Ch	217 10.4 Jo	246 8.9 BL	210 5.8 Hr	238 11.4 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RR PER
022150
236 8.0 Br
239 8.7 L
240 8.2 Pt
251 8.6 Bw

R FOR
022426
210 11.6 Bl

U CET
022813
240 7.9 Pt
247 8.5 Fd
248 8.6 BL
253 8.8 BL
254 8.4 Gy
260 8.6 BL
262 8.8 Gy

RR CEP
022980
236[13.5 Br
239[14.5 L
247[13.5 Br

R TRI
023133
217 7.8 Jo
224 7.4 Jo
226 7.4 Hr
227 7.4 Hr
228 7.4 Hr
229 6.7 Tf
230 7.3 Hr
230 7.4 Jo
234 7.0 Ah
234 7.3 Hr
235 6.6 Tf
238 6.9 Jo
239 7.9 Hr
240 7.0 Hr
240 6.7 Pt
241 6.6 Tf
241 7.0 Hr
242 6.8 Ch
243 6.6 Jo
243 6.8 Hr
246 6.5 Tf
246 6.5 Wd
247 6.0 Sf
248 6.3 Ma
248 6.9 Hr
250 6.8 Hr
252 6.7 Ah
253 6.9 Wd
253 7.0 Hr
254 6.9 Gy
260 6.3 Wd
262 6.1 Sf
262 6.5 Gy
263 6.2 Wd

W PER
024356
217 10.0 Jo
224 9.9 Jo
232 9.9 Jo
236 9.7 Me
240 9.8 Pt
242 9.4 Jo
247 9.3 Me
250 10.2 Bw
266 9.9 Bw
269 10.0 Mc

R HOR
025050
161 7.8 Sl
179 8.3 Sl
193 8.6 Sl
204 9.0 Sl
210 10.0 Bl
211 10.1 Ht
223 10.0 Sl
235 10.5 Sl
248 11.4 Sl

T HOR
025751
210[13.3 Bl
211[12.2 Ht

U ARI
030514
236 13.0 Br
244 13.0 L

X CET
031401
217 11.0 Jo
232 11.5 Jo
237 10.9 L
240 11.1 Pt
247 10.4 Br
247 10.5 Fd

Y PER
032043
230 8.3 Jo
234 9.7 Ah
238 8.5 Jo
240 8.5 Pt
242 8.7 Jo
246 9.0 BL
248 9.3 BL
252 9.2 Ah
253 9.1 BL
260 9.3 BL
263 9.2 BL
264 8.5 Mc

R PER
032335
232 9.5 Jo
236 8.9 Br
239 9.3 Jo
240 9.2 Pt
244 9.3 L

R PER
032335
247 9.2 Ma

T FOR
032528
224 8.9 L
236 9.0 L
246 9.3 L

U ERI
034625
246 13.7 L

R TAU
042209
219 8.7 Jo
223 8.5 Jo
240 9.4 Pt
248 10.1 Ma

W TAU
042215
217 10.2 Jo
223 10.0 Jo
228 10.6 L
230 10.1 Jo
238 10.7 Jo
240 11.2 Pt
242 10.8 Jo
246 11.3 L
250 11.2 Bw
266 11.9 Bw

S TAU
042309
219 10.3 Jo
223 10.5 Jo
240 11.5 Pt
249 11.9 Ma

T CAM
043065
219 7.8 Jo
230 8.0 Jo
234 7.9 Jo
237 7.9 L
238 8.1 Jo
240 7.9 Pt
260 8.5 BL

RX TAU
043208
240 10.0 Pt
242 10.4 L
247 10.2 Fd
250 10.3 Bw
266 10.7 Bw

R RET
043263
161 10.6 Sl
171 11.2 Sl
179 11.6 Sl
210 12.7 Bl
211 12.1 Ht
211 12.8 Sl
223 13.2 Sl

R RET
043263
235 13.8 Sl
240 14.0 Sl

X CAM
043274
237 8.7 L
240 8.2 Pt

R DOR
043562
161 5.5 Sl
171 5.8 Sl
179 5.5 Sl
193 5.7 Sl
204 5.5 Sl
210 5.4 Bl
211 5.2 Ht
211 5.5 Sl
223 5.3 Sl
235 5.1 Sl
240 5.1 Sl
249 4.8 Sl

R PIC
044349
210 9.5 Bl

V TAU
044617
240 11.9 Pt

R ORI
045307
228 11.7 L
238 10.1 Jo
242 10.0 Jo
246 11.1 L

R LEP
045514
179 7.1 Sl
193 6.7 Sl
211 6.2 Sl
223 5.9 Sl
223 7.0 Jo
224 6.6 Jo
228 6.8 Jo
228 7.0 L
238 5.8 Sl
238 7.4 Fd
240 6.8 Pt
243 7.5 L
249 6.0 Sl

V ORI
050003
223 10.8 Jo
228 11.1 L
230 10.7 Jo
240 9.8 Pt
246 10.0 L

T LEP
050022
240 11.6 Pt

R AUR
050953
117 9.1 Hr
222 9.0 Hr
227 9.0 Hr
234 8.7 Ah
237 7.6 Me
238 8.8 Br
240 8.8 Pt
247 9.1 Fd
250 7.6 Me
252 9.3 Ah
258 7.6 Me

NOV TAU
051316
242 14.7 L

S AUR
052034
240 9.3 Pt
243 9.4 Jo
247 10.3 Fd
264 10.4 Mc
272 10.7 Mc

W AUR
062036
238 11.7 Fd
240 11.6 Pt
242 11.7 L
247 11.9 Br
247 11.8 Fd

S ORI
052404
240 9.3 Pt

T ORI
053005a
223 11.0 Jo
224 9.6 Jo
224 10.4 L
226 10.3 L
227 10.2 L
235 10.2 L
236 10.2 L
237 10.2 L
238 10.1 L
238 9.6 Fd
239 10.1 L
240 10.2 L
240 9.9 Pt
241 10.3 Pt
242 10.2 L
243 10.2 L
244 10.2 L
245 10.4 Pt
246 10.4 Pt
246 10.2 L
247 10.3 L
247 10.0 Fd
254 10.6 Pt

AN ORI
053005t
238 11.5 L
242 11.6 L

S CAM
053068
230 8.5 Jo
232 8.7 Jo
239 9.7 Pc
240 8.8 Pt
262 9.0 Pc

RR TAU
053326
224 11.0 L
226 11.0 L
228 10.9 L
229 10.9 L
230 11.0 L
236 11.1 L
237 11.1 L
238 10.9 L
239 11.0 L
240 10.9 L
242 10.9 L
243 10.8 L
244 10.9 L
246 10.9 L
247 10.1 L
247 10.6 Br

RU AUR
053337
240 9.7 Pc
240 10.3 Pt
247 10.0 Br

U AUR
053531
228 13.4 L
240 12.7 Pt
247 13.6 Br

SU TAU
054319
224[13.8 L
226[13.3 L
229[13.8 L
230[13.2 L
235[13.3 L
236[13.3 L
237[13.8 L
238[15.2 L
239[15.2 L
240[13.1 Pt
241[12.1 Pt
242[13.8 L
243[13.8 L
244[14.6 L
245[12.5 Pt
246 15.4 L
254[11.5 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z TAU	V AUR	R GEM	RT HYA	R LMI	W VEL
054615a	061647	070122a	*082405*	093934	*101153*
242 13.5 L	228 9.5 L	246 13.5 Pt	246 7.7 Pt	085 10.5 Hr	209 11.5 Bl
247 13.5 Br	246 10.5 By	Z GEM	R CHA	112 8.2 Hr	RZ CAR
RU TAU	264 10.5 Mc	070122b	*082476*	117 8.1 Hr	*103270*
054615c	272 10.0 Mc	246 7.8 Pt	209 13.0 Bl	118 8.1 Hr	201 10.8 En
242[14.0 L	V MON	TW GEM	U CNC	122 7.6 Hr	R UMA
247[13.5 Br	*061702*	070122c	083019	127 7.4 Hr	103769
α ORI	240 8.0 Pt	246 12.5 Pt	229[11.9 L	133 7.7 Hr	217 9.4 Jo
054907	AG AUR	R CMI	X UMA	246 10.1 Pt	224 9.2 Jo
211 0.3 Sl	062047	070310	083350	R LEO	229 8.0 Sz
228 0.5 L	228 9.5 L	244 8.4 L	246 9.1 Pt	094211	230 8.0 Jo
235 0.3 Sl	242 9.2 L	L_2 PUP	S HYA	083 8.4 Hr	234 7.7 Ah
239 0.5 L	SU CAM	*071044*	084803	085 8.5 Hr	237 7.6 Sz
249 0.1 Sl	062573	161 5.3 Sl	246 8.6 Pt	088 8.4 Hr	238 7.7 Jo
U ORI	246 13.5 By	179 5.1 Si	249 8.5 Ch	110 8.0 Hr	238 7.7 Fd
054920a	250 13.4 By	193 4.5 Sl	T HYA	112 7.4 Hr	239 7.5 Pc
230 10.5 Jo	U LYN	211 4.4 Sl	*085008*	117 7.0 Hr	242 7.6 Jo
238 10.7 Jo	063159	223 3.9 Sl	242[11.9 L	118 7.0 Hr	243 7.5 Sz
238 10.1 Fd	247 14.0 Br	235 3.9 Sl	T CNC	122 6.9 Hr	246 7.5 Sz
240 9.8 Pt	AA AUR	248 4.3 Sl	085120	127 6.5 Hr	246 7.5 Wd
248 9.1 GD	063444	V GEM	246 8.3 Pt	133 6.5 Hr	246 7.0 Pt
249 8.7 Sl	213[13.0 By	071713	V UMA	238 8.6 Fd	247 7.6 Wd
252 9.0 Ah	246[12.5 By	226 11.5 L	090151	246 8.6 Ch	247 7.6 Fd
V CAM	S LYN	244 12.4 L	242 10.3 L	246 8.2 Pt	248 7.7 Wd
054974	063558	246 11.5 Pt	W CNC	Z VEL	252 7.4 Ah
242 13.0 L	240 12.0 Pt	S CMI	090425	*094953*	253 7.5 Wd
Z AUR	242 11.6 L	072708	228 9.2 L	201 12.5 En	254 7.0 Gy
055353	247 10.8 Br	223 8.0 Jo	246 10.0 L	209 12.2 Bl	260 7.6 Wd
237 9.9 Pt	X GEM	230 8.0 Jo	RX UMA	V LEO	261 7.7 Gy
238 9.9 Pt	064030	238 7.5 Fd	090567	095421	261 7.1 Pc
238 10.3 Fd	115 8.7 Bn	246 7.0 Pt	242 10.2 L	246 11.4 Pt	262 7.2 Al
239 9.9 Pt	266 11.9 Bn	249 7.5 Ch	RW CAR	RV CAR	263 7.6 Wd
240 9.7 Pt	Y MON	T CMI	*091868*	*095563*	263 7.7 Mc
241 9.8 Pt	065111	072811	197 10.0 Bl	201[12.3 En	269 7.9 Mc
245 9.8 Pt	240 12.8 Pt	226 11.0 L	201 10.2 Ht	209[13.1 Bl	271 8.2 Mc
246 9.6 Pt	244 13.4 L	244 10.6 L	207 10.5 En	S CAR	V HYA
247 9.5 Pt	X MON	246 11.1 Pt	209 10.4 Bl	*100661*	*104620*
248 9.7 Pt	*065208*	S VOL	211 11.4 En	161 6.5 Sl	209 6.5 Bl
249 9.6 Pt	238 7.8 L	*073173*	Y VEL	171 7.9 Sl	RS HYA
251 9.7 Pt	247 7.8 L	197 10.9 Bl	*092551*	179 8.4 Sl	*104628*
254 9.6 Pt	R LYN	209 11.9 Bl	209 10.2 Bl	185 8.6 Sl	209[13.0 Bl
264 9.8 Mc	065355	U CMI	R CAR	201 8.4 Ht	RS CAR
272 9.7 Mc	234 8.2 Ah	073508	*092062*	201 8.1 En	*110361*
R OCT	240 7.6 Pt	224 9.7 L	171 7.7 Sl	204 8.1 Sl	171[12.3 Sl
055686	244 7.8 L	244 9.6 L	179 7.2 Sl	208 8.0 Ht	185[12.3 Sl
197 8.2 Bl	247 7.8 Br	246 9.3 Pt	185 7.0 Sl	209 8.0 Bl	204[12.3 Sl
208 8.8 Ht	252 8.4 Ah	S GEM	193 6.8 Sl	211 7.5 En	223[12.3 Sl
209 8.8 Bl	Z CMA	073723	201 6.8 En	214 7.5 Ht	249[12.3 Sl
219 9.7 Ht	065911	246 11.4 Pt	209 6.2 Bl	219 6.8 Ht	RY CAR
X AUR	179 10.0 Sl	T GEM	211 6.3 En	223 6.8 Sl	*111561*
060450	193 10.0 Sl	074323	211 5.9 Sl	234 6.3 Sl	201 13.1 Ht
224 9.1 Lj	211 10.0 Sl	246 10.2 Pt	235 5.3 Sl	249 5.9 Sl	208[12.7 Ht
229 9.1 Lj	223 10.1 Sl	R CNC	249 4.6 Sl	Z CAR	209[12.7 Bl
236 9.3 Li	235 10.0 Sl	081112	Y DRA	*101058a*	211[13.1 En
240 8.6 Pt	248 10.2 Sl	246 10.1 Pt	093178	201[12.3 Ht	214[12.7 Ht
240 8.7 Pc	V CMI	249 10.3 Ch	225 10.6 L	209[12.6 Bl	RS CEN
242 8.8 L	070109	V CNC	244 9.5 L	W VEL	*111661*
250 9.3 Li	244 9.2 L	081617		*101153*	201 8.6 Ht
		246 11.5 Pt		201 12.0 En	201 8.8 En

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RS CEN	R VIR	S UMA	S VIR	Z BOO	S BOO
111661	123307	123961	*132706*	140113	141954
208 9.2 Ht	083 9.6 Hr	247 9.0 Wd	208 8.4 Ht	228 10.6 L	243 9.7 Jo
209 9.1 Bl	085 9.0 Hr	247 9.0 Ma	211 8.0 Sl	RU HYA	247 9.3 L
211 9.5 En	088 9.0 Hr	250 9.4 Lj	211 8.2 En	*140528*	250 9.2 Be
214 9.9 Ht	103 7.7 Hr	252 8.9 Ah	214 8.3 Ht	194 10.1 En	RS VIR
219 10.0 Ht	112 7.4 Hr	253 9.3 Wd	239 9.2 Sl	195 9.9 En	142205
X CEN	114 7.4 Hr	260 8.7 Wd	RV CEN	200 9.3 En	229 11.8 L
114441	118 7.3 Hr	262 8.6 Fd	*133155*	201 9.7 Ht	239 10.3 L
209 9.3 Bl	121 7.0 Hr	262 8.4 Pc	201 7.9 Ht	205 9.0 En	V BOO
AD CEN	122 7.0 Hr	270 9.1 Mc	208 8.6 Ht	208 9.3 Ht	142539a
114858	126 7.0 Hr	U OCT	209 7.8 Bl	209 9.0 Bl	122 9.9 Hr
201 9.3 Ht	131 7.1 Hr	*131283*	211 8.3 En	211 9.1 En	214 8.3 Ch
208 9.4 Ht	140 7.3 Hr	194 10.3 En	219 8.6 Ht	219 8.6 Ht	217 7.7 Jo
214 9.4 Ht	145 7.9 Hr	206 10.7 En	T UMI	R CEN	224 7.5 Jo
219 9.5 Ht	RS UMA	208 10.8 Ht	133273	*140959*	230 7.6 Jo
W CEN	123459	209 10.7 Bl	239 12.8 L	171 6.8 Sl	232 7.5 Pt
115058	083 9.6 Hr	211 11.0 En	T CEN	179 6.6 Sl	234 7.5 Ah
201 11.5 Ht	231 10.4 Jo	V CVN	*133633*	194 6.2 En	236 7.5 Fd
201 11.2 En	238 10.2 Jo	131546	171 7.0 Sl	200 6.1 En	238 7.8 GD
208 10.7 Ht	243 10.4 Jo	237 7.5 GD	179 7.3 Sl	201 5.7 Ht	238 7.5 Jo
209 9.8 Bl	246 10.4 Jo	238 7.4 GD	183 7.3 Sl	208 5.9 Ht	240 7.5 Fd
211 10.3 En	261 13.4 Bn	240 7.5 GD	185 7.7 Sl	209 5.9 Bl	243 7.6 Jo
214 10.1 Ht	266 12.4 Bn	241 7.7 GD	194 7.4 En	211 6.2 Sl	247 7.9 Sf
219 9.5 Ht	S UMA	248 7.5 GD	200 7.0 En	211 6.0 En	248 7.5 GD
R CRV	123961	250 7.5 GD	201 7.2 Ht	219 5.9 Ht	252 7.6 Ah
121418	083 8.1 Hr	258 7.1 GD	204 6.5 Sl	235 6.2 Sl	258 7.8 GD
171 12.0 Sl	085 8.0 Hr	259 7.5 GD	208 6.5 Ht	239 6.1 Sl	259 7.6 GD
179 11.7 Sl	088 8.0 Hr	260 7.5 GD	209 6.5 Bl	247 6.2 Sl	260 7.8 GD
204 10.4 Sl	103 7.9 Hr	261 7.5 GD	211 6.3 En	U UMI	260 7.9 Sf
234 8.3 Sl	105 8.0 Hr	R HYA	211 6.2 Sl	141567	271 8.2 Mc
T CVN	110 8.4 Hr	*132422*	214 6.2 Ht	222 9.9 Lj	R CAM
122532	112 8.5 Hr	171 9.1 Sl	219 5.9 Ht	224 9.9 Lj	142584
232 10.2 Pt	117 8.5 Hr	179 9.0 Sl	234 6.0 Sl	229 10.3 Lj	214 8.0 Ch
U CEN	118 8.6 Hr	183 8.0 Sl	239 6.0 Sl	232 10.3 Lj	219 8.0 Jo
122854	120 8.6 Hr	194 9.5 En	RT CEN	232 10.1 Pt	234 8.5 Ah
208 12.3 Ht	121 8.6 Hr	200 9.1 En	*134236*	232 9.2 Jo	236 8.4 Br
209 13.0 Bl	122 8.6 Hr	201 9.4 Ht	201 10.0 Ht	233 10.4 Lj	239 8.4 Jo
211 12.3 En	126 8.7 Hr	208 9.0 Ht	208 10.0 Ht	234 10.2 Jo	243 8.4 Jo
T UMA	131 8.8 Hr	209 8.9 Bl	209 9.9 Bl	234 10.2 Ah	252 9.0 Ah
123160	145 9.1 Hr	211 8.3 Sl	211 9.7 En	236 10.5 Lj	R BOO
113 9.0 Hr	214 11.8 Ch	211 9.0 En	214 9.9 Ht	238 10.5 Lj	143227
117 8.9 Hr	217 11.8 Jo	214 8.7 Ht	219 9.9 Ht	239 9.5 Jo	214 7.7 Ch
118 8.8 Hr	223 11.6 Lj	234 7.5 Sl	R CVN	239 10.2 Pc	217 8.0 Jo
120 8.6 Hr	229 11.3 Lj	239 7.4 Sl	134440	246 10.5 Sz	223 8.0 Ch
121 8.6 Hr	230 10.9 Lj	248 7.4 Sl	232 11.7 Pt	246 10.6 Lj	223 8.1 Lj
122 8.5 Hr	232 10.9 Lj	S VIR	RX CEN	246 10.3 Jo	224 7.6 Jo
126 8.1 Hr	232 11.2 Pt	*132706*	*134536*	250 10.7 Lj	229 8.6 Lj
131 8.1 Hr	233 10.8 Lj	118 8.6 Hr	201 13.1 Ht	252 10.7 Ah	230 8.4 Jo
140 9.8 Hr	234 10.8 Ah	121 8.2 Hr	209 13.1 Bl	262 10.8 Pc	232 8.5 Pt
145 8.2 Hr	236 10.4 Lj	126 7.6 Hr	211 13.1 En	S BOO	232 8.7 Lj
160 8.6 Hr	238 10.4 Lj	131 7.6 Hr	T APS	141954	233 8.7 Lj
214 11.0 Ch	238 10.0 Jo	145 7.2 Hr	*134677*	214 11.5 Ch	234 8.7 Ah
217 11.5 Jo	239 10.3 Pc	171 6.7 Sl	194 9.0 En	217 10.5 Jo	236 9.1 Lj
224 11.7 Jo	240 10.3 Fd	179 6.8 Sl	200 9.0 En	224 10.2 Jo	238 9.4 Lj
231 12.0 Jo	243 9.8 Jo	185 7.0 Sl	208 9.5 Ht	228 10.9 L	238 8.7 GD
232 11.7 Pt	244 10.0 Lj	194 7.9 En	209 9.3 Bl	230 10.1 Jo	238 8.8 Jo
239 11.5 Pc	246 10.0 Lj	200 8.2 En	211 9.0 En	232 10.1 Pt	240 8.7 GD
262 11.5 Pc	246 9.2 Jo	201 7.6 Ht	219 9.7 Ht	238 9.8 Jo	243 8.8 Jo
	246 9.0 Wd	204 7.8 Sl		238 10.1 GD	244 9.8 Lj

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R Boo	RS LIB	R CRB	R CRB	R LUP	W Sco
143227	*151822*	154428	154428	*154736*	*160519*
246 9.7 Lj	209 9.9 Bl	217 6.0 Jo	247 6.0 Wd	206 9.9 En	209[13.8 Bl
248 9.7 Sz	212 10.2 En	222 6.1 Be	247 6.2 Lj	212 9.7 En	RU HER
250 10.0 Lj	212 10.2 Ht	222 5.9 Tf	247 6.0 L	RR LIB	160625a
252 9.9 Ah	230 8.6 L	222 6.2 Lj	248 6.1 Ft	*155018*	237 13.8 L
V LIB	R NOR	223 6.0 Be	248 6.0 Wd	231 14.2 B	243 13.6 Ch
143417	*152849*	224 6.2 Lj	249 6.1 Be	237[14.0 L	R Sco
230 11.2 L	195 8.2 En	224 6.0 Jo	249 6.2 Pt	Z CRB	*161122a*
S LUP	200 8.4 En	224 6.0 L	250 6.1 Pt	155229	207[12.6 Ht
144646a	201 8.9 Ht	225 6.1 Be	250 5.2 Lj	228 10.0 L	209[13.4 Bl
211[12.1 En	208 8.7 Ht	225 6.2 Lj	250 6.0 Wd	231 10.4 B	212[13.0 En
217[12.1 En	209 8.3 Bl	226 6.0 L	250 5.9 Tf	237 11.0 Mg	S Sco
Y LUP	212 8.5 En	228 6.0 L	251 6.0 Pt	243 10.9 Ch	*161122b*
145254	219 8.9 Ht	229 6.0 L	253 6.0 Wd	247 10.9 L	206[13.0 En
209[13.7 Bl	X LIB	229 6.2 Lj	253 6.1 Pt	RZ Sco	209[13.4 Bl
211[13.7 En	*153020*	229 6.1 Be	259 6.2 Pt	*155823*	212[12.6 Ht
S APS	209[12.8 Bl	229 6.0 Tf	260 6.2 Pc	206 12.6 En	W CRB
145971	W LIB	230 6.2 Lj	260 6.0 GD	207 12.0 Ht	161138
194 10.1 En	*153215*	230 5.9 L	260 5.9 Wd	212 13.0 En	235 11.4 B
200 10.1 En	209[13.4 Bl	231 6.0 Jo	261 6.2 Pt	Z Sco	237 11.2 Pt
201 10.3 Ht	S UMI	231 6.2 Pt	261 6.2 Pc	*160021*	239 11.5 Pc
208 10.3 Ht	153378	232 6.2 Lj	261 6.0 GD	206 10.1 En	250 11.7 Bc
209 10.0 Bl	222 8.7 Lj	232 6.2 Pt	262 6.0 Pc	207 10.2 Ht	251 10.4 Pc
211 10.1 En	224 8.9 Lj	233 6.2 Lj	262 6.0 Gy	209 9.9 Bl	261 10.1 Md
219 10.3 Ht	229 8.7 Lj	234 6.0 L	263 6.0 Wd	212 10.0 En	W OPH
Y LIB	232 8.7 Lj	235 6.0 L	271 6.2 Mc	212 10.1 Ht	*161607*
150605	232 8.4 Pt	235 6.2 Lj	X CRB	229 9.8 L	237 13.3 L
230[12.4 L	234 8.5 Ah	235 6.0 Tf	154536	R HER	V OPH
U CRB	236 8.9 Lj	236 6.2 Lj	230 12.8 L	160118	*162112*
151432	237 8.6 Mg	236 6.2 Pt	231 13.1 B	235[13.2 B	228 8.5 L
232 8.2 Jo	240 8.6 B	236 6.1 Ch	243 12.9 Ch	236[12.0 Fd	237 8.5 Pt
238 7.8 Jo	241 8.4 Me	236 6.2 Fd	247 12.8 L	RR HER	247 8.3 L
246 7.7 Jo	244 9.0 Li	237 6.1 Be	247 12.4 Ma	160150	U HER
S LIB	246 8.7 Lj	237 6.0 Mg	R SER	241 8.1 Me	162119
151520	247 8.4 Sf	237 6.1 Pt	154615	U SER	219 10.6 Jo
230 9.6 L	250 8.7 Lj	237 6.0 L	232 12.0 Pt	160210	224 10.2 Jo
S SER	252 8.5 Ah	238 6.0 L	243 11.4 Ch	232 12.2 Pt	231 11.2 Ch
151714	254 8.3 Gy	238 6.1 Pt	V CRB	X Sco	236 11.0 Ch
224 9.0 L	261 8.6 Gy	238 6.0 Jo	154639	*160221a*	236 10.6 Fd
232 8.6 Pt	262 8.7 Gy	238 6.1 Wd	228 7.1 Hr	209[13.0 Bl	237 10.3 Pt
239 8.4 Jo	262 8.5 Sf	239 5.9 Pc	230 7.0 Hr	SX HER	238 10.0 Jo
239 11.0 Pc	U LIB	239 6.1 Pt	231 7.0 B	160325	239 10.9 Pc
239 8.7 L	*153620a*	240 6.1 Pt	232 6.6 Pt	228 8.3 L	240 9.4 Fd
261 8.8 Pc	209 9.2 Bl	240 6.1 Pc	234 7.2 Hr	231 8.3 Pt	242 10.2 Jo
S CRB	T NOR	241 6.1 Pc	237 7.3 Mg	232 8.4 Pt	242 10.9 Sf
151731	*153654*	241 5.9 GD	240 7.3 Hr	236 8.6 Pt	247 10.7 Sf
214 12.1 Ch	201 10.5 Ht	241 6.2 Pt	243 6.8 Ch	237 8.6 Pt	252 10.0 B
231 11.5 B	206 10.5 En	242 6.2 Pt	243 7.1 BL	237 8.7 L	261 10.5 Pc
232 10.5 Jo	208 10.9 Ht	242 6.0 Jo	248 7.3 BL	238 8.4 Pt	262 10.4 Sf
232 11.7 Pt	212 10.1 En	243 6.1 Be	253 7.2 BL	239 8.6 Pt	SS HER
238 10.8 Jo	219 11.3 Ht	243 6.2 Pt	253 7.4 Hr	242 8.5 Pt	162807
246 10.6 Jo	Z LIB	244 6.1 Be	259 7.1 BL	243 8.5 Pt	230 10.3 L
252 9.4 Ah	*154020*	244 6.0 Mg	262 7.6 Md	245 8.5 Pt	235 11.0 B
262 9.0 Sf	209 11.9 Bl	244 6.1 Ch	R LIB	247 8.8 L	237 11.4 Pt
RS LIB	R CRB	245 6.2 Pt	*154715*	248 8.7 Pt	243 11.6 Ch
151822	154428	246 6.2 Pt	230 12.3 B	249 8.8 Pt	247 12.2 L
194 10.6 En	188 6.4 Jn	246 6.0 Jo	237 12.7 L	250 8.8 Pt	T OPH
200 10.5 En	189 6.1 Jn	246 6.2 Lj	252 10.2 Ah	259 9.0 Pt	*162815*
207 10.4 Ht	214 6.1 Ch	246 6.1 Wd		261 9.1 Pt	209[13.1 Bl

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J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

T OPH
162815
237[12.8 L
S OPH
162816
209[13.2 Bl
237 14.2 L
W HER
163137
209 11.8 By
214 11.6 By
215 11.6 By
217 11.7 By
231 10.7 B
231 11.5 Ch
235 11.3 By
236 11.6 Fd
237 11.2 By
237 11.4 Pt
238 11.1 Fd
239 10.5 Pc
240 11.4 Fd
246 10.3 By
247 10.2 Ma
248 10.6 Sz
250 10.0 By
261 9.2 Pc
262 9.4 Sf
262 9.9 Fd
R UMI
163172
217 8.6 Jo
230 8.6 Jo
234 8.9 Jo
239 8.6 Jo
263 10.2 Mc
271 10.2 Mc
R DRA
163266
222 12.1 Lj
223 12.0 Jo
230 11.8 Jo
232 11.9 Lj
236 11.8 Lj
237 12.0 Pt
238 11.7 Lj
238 11.2 Fd
239 11.7 Jo
240 11.5 Fd
242 11.6 Jo
244 11.3 Lj
246 11.2 Lj
246 11.6 Jo
246 11.2 Wd
247 10.9 Wd
247 11.1 Ma
247 11.1 Fd
248 11.0 Wd
250 11.1 Lj
252 10.3 Ah

R DRA
163266
256 10.8 Wd
260 10.6 Wd
262 10.4 Fd
262 9.6 Gy
263 10.4 Wd
RR OPH
164319
206 8.4 En
212 8.3 En
228 8.3 L
237 8.3 Pt
247 8.7 L
S HER
164715
217 8.8 Jo
224 8.5 Jo
231 9.3 B
232 9.4 Jo
237 9.5 Pt
238 9.4 Jo
242 10.2 Jo
243 9.6 Ch
RS SCO
164844
206 7.8 En
207 7.8 Ht
209 7.9 Bl
212 8.2 Ht
212 7.8 En
RR SCO
165030a
120 7.6 Hr
121 7.5 Hr
122 7.5 Hr
126 7.3 Hr
131 7.2 Hr
145 7.0 Hr
160 6.7 Hr
171 6.0 Sl
180 6.2 Sl
206 6.9 En
207 7.1 Ht
209 7.3 Hr
209 7.4 Bl
211 7.4 Hr
211 7.2 Sl
212 7.4 En
212 7.4 Ht
225 8.8 Hr
227 8.9 Hr
231 9.0 Hr
233 9.1 Hr
239 8.4 Si
239 9.2 Hr
SS OPH
165202
244 13.0 Ch

RV HER
165631
230 12.1 L
231 11.9 B
236 11.2 Ch
237 11.0 Pt
238 10.0 Fd
239 10.8 Jo
242 10.5 Jo
244 10.2 Be
246 9.6 Jo
246 10.2 Be
247 10.3 Bw
247 9.9 L
250 10.2 Be
262 10.7 Md
RT SCO
165636
206 10.2 En
209 9.8 Bl
212 9.6 En
— DRA
165752
237 11.7 L
R OPH
170215
117 7.7 Hr
118 7.8 Hr
120 7.7 Hr
121 7.7 Hr
122 7.7 Hr
126 8.0 Hr
127 8.1 Hr
131 8.2 Hr
145 8.7 Hr
160 9.3 Hr
230 11.6 L
239 12.5 Ch
RT HER
170627
235 14.3 B
237 13.8 L
239 12.0 Jo
RW SCO
170833
206 11.7 En
209 11.0 Bl
214 10.7 En
Z OPH
171401
237 9.3 Pt
252 9.8 Ah
253 9.4 B
RS HER
171723
231 9.3 B
234 9.3 Ah
237 9.4 Mg
237 8.9 Pt
239 8.8 Jo

RS HER
171723
242 8.7 Jo
243 9.1 Bw
246 8.5 Jo
252 8.4 Ah
S OCT
172486
206 9.4 En
208 10.0 Ht
209 9.4 Bl
212 9.0 En
219 9.1 Ht
RU OPH
172809
229 12.0 L
237 11.5 Pt
239 11.7 Ch
247 11.4 L
247 11.1 Ma
248 11.5 BL
252 11.0 B
253 11.3 BL
270 10.4 Fe
RT SER
173411
238 12.6 L
RU SCO
173543
206 10.1 En
209 10.1 Bl
214 10.0 En
SV SCO
174135
206 11.4 En
209 11.2 Bl
214 11.8 En
W PAV
174162
201 10.7 Ht
206 9.9 En
208 10.2 Ht
209 9.9 Bl
214 9.5 En
219 9.8 Ht
RS OPH
174406
237 11.1 Pt
U ARA
174551
207[13.0 Ht
214[12.3 En
RT OPH
175111
238[13.7 L
239[12.5 Ch
247[13.7 Bw
T DRA
175458a
238 11.4 Mg

T DRA
175458a
243 10.8 BL
243 10.8 Ch
246 11.0 BL
248 11.0 BL
252 10.8 B
253 11.0 BL
260 10.9 BL
263 10.8 BL
UY DRA
175458b
238 11.6 Mg
243 11.0 Ch
246 11.0 BL
248 10.9 BL
252 11.4 B
253 10.9 BL
260 10.9 BL
263 10.8 BL
RY HER
175519
229 11.6 L
237 11.6 Pt
239 12.7 Ch
247 12.0 L
247 12.9 Bw
247 13.1 Ma
252 12.9 B
V DRA
175654
238 13.7 L
239 12.7 Ch
R PAV
180363
206 11.4 En
207 11.7 Ht
212 11.9 Ht
214 11.8 En
T HER
180531
145 9.7 Hr
160 8.7 Hr
194 8.5 Hr
209 9.2 Hr
210 9.4 Hr
232 11.0 Bc
236 12.2 Fd
237 10.4 Me
237 11.5 Pt
238 12.5 L
238 12.0 Fd
239 12.5 Ch
242 13.1 Tf
242 12.7 Al
W DRA
180565
238 14.0 Br

X DRA
180666
238 13.8 Br
238 13.7 L
RY OPH
181103
185 13.8 Sl
204 12.3 Sl
211 10.6 Sl
230 8.7 Jo
234 8.7 Sl
235 8.8 Jo
237 9.4 Pt
238 8.8 Jo
239 8.5 Sl
248 8.4 Sl
252 9.2 Ah
253 9.1 B
W LYR
181136
217 9.8 Jo
232 10.0 Jo
234 10.8 Ah
237 10.7 Pt
238 10.7 L
238 10.5 Jo
238 11.0 Fd
238 10.9 Wd
240 11.0 Wd
242 11.9 Al
260 11.6 Wd
RV SGR
182133
207 11.9 En
209 11.7 Bl
214 11.9 En
SV HER
182224
238 13.8 Br
238 13.9 L
247 13.5 Bw
T SER
182306
219 9.9 Jo
231 9.6 Jo
237 10.5 Pt
238 9.5 Jo
238 11.3 Mg
242 9.2 Jo
243 11.2 Ch
247 11.6 Bw
252 11.7 B
SV DRA
183149
235 13.9 L
238 13.5 Br
247 13.4 Ma
RZ HER
183225
238 14.1 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
X OPH	R SCT	R SCT	ST SGR	RX SGR	T SGR
183308	*184205*	*184205*	*185512a*	*190818*	*191017*
217 7.5 Jo	237 6.0 GD	259 6.3 GD	242 8.6 Ch	207[12.4 Ht	242 12.0 Ch
231 7.7 Jo	237 6.0 Me	259 6.2 Pt	244 8.6 Mg	214[12.7 En	R SGR
231 8.1 Hr	237 5.6 Pt	260 6.2 GD	270 9.2 Fe	238 13.1 L	*191019*
237 8.0 Pt	237 6.1 Mg	260 5.8 Pc	R CRA	242 13.1 Ch	207 7.7 Ht
238 8.1 L	238 5.8 Pt	260 6.1 Bg	*185537a*	244[13.1 Mg	207 7.9 En
238 8.3 Jo	238 5.7 Jo	260 6.4 Wd	161 12.5 Sl	247[12.7 Bw	210 7.9 Hr
240 8.5 Hr	238 5.8 Fd	260 6.3 Me	171 12.5 Sl	248[12.7 Ma	212 8.0 Ht
241 8.5 Hr	238 6.0 Bc	261 6.2 Pt	183 12.0 Sl	RW SGR	214 8.0 En
242 8.3 Jo	238 5.9 Pc	261 5.8 Pc	186 12.0 Sl	*190819a*	226 8.5 Hr
242 8.0 Al	238 5.7 GD	261 6.2 GD	209 12.8 Bl	207 10.0 Ht	227 8.5 Hr
243 8.0 Ch	238 6.0 Wd	262 5.9 Pc	211 13.8 Sl	207 9.9 En	230 8.5 Hr
249 8.7 Hr	239 5.9 Pc	262 6.1 Gy	212 12.5 Ht	212 9.9 Ht	237 8.2 Pt
252 8.6 Ah	239 5.7 Pt	262 6.2 Fd	214 12.5 En	214 9.9 En	239 9.0 L
252 8.4 B	240 5.8 Pt	263 7.1 Mc	235 12.8 Sl	237 9.2 Pt	240 8.7 Hr
253 8.7 Hr	240 5.7 Pc	263 6.4 Wd	240 12.5 Sl	238 9.4 L	240 8.8 Ch
257 7.8 Al	240 5.9 Sl	269 6.5 Mc	248 12.1 Sl	242 9.7 Ch	244 8.6 Hr
RS DRA	240 6.1 Wd	271 6.6 Mc	T CRA	244 9.6 Mg	260 9.9 Me
184074	240 5.8 Fd	272 6.5 Mc	*185537b*	247 9.6 Bw	RY SGR
246 9.3 By	241 5.8 Pc	RW LYR	161 12.8 Sl	248 9.6 Ma	*191033*
RY LYR	241 6.2 Bg	184243	171 13.0 Sl	BH SGR	200[12.4 En
184134	241 6.0 Me	238[13.7 Br	183 13.3 Sl	*190819b*	207[12.4 En
238[13.2 Br	241 5.8 Pt	239[14.2 Br	186 13.3 Sl	238[13.1 L	207[12.5 Ht
238[14.8 L	242 5.8 Pt	Nov AQL	209 13.3 Bl	244 12.8 Mg	209[13.2 Bl
239[12.5 Ch	242 5.8 Jo	184300	211 13.3 Sl	TY AQL	232[12.1 Pt
R SCT	243 5.8 Be	217 10.4 Jo	214 13.0 En	*190907*	234[13.0 L
184205	243 5.6 Ch	230 10.5 Jo	235 13.0 Sl	237 10.1 Pt	235 13.5 L
161 6.1 Sl	243 5.9 Pt	232 11.7 Pt	240 13.7 Sl	247 10.5 Bw	236[12.1 Pt
171 5.8 Sl	244 6.0 Mg	238 10.6 Jo	Z LYR	S LYR	237[12.1 Pt
183 5.5 Sl	245 5.7 Be	242 10.6 Jo	185634	190925	238[12.1 L
189 5.1 Sl	245 5.9 Pt	243 10.5 Ch	237 10.3 Pt	238 14.0 Br	239[12.1 Pt
204 5.1 Sl	246 5.9 Pt	245 11.5 Pt	239 10.3 L	239 14.2 L	242[11.5 Pt
211 5.2 Sl	246 6.2 Al	247 10.9 Ma	239 10.3 Br	X LYR	243[10.0 Ch
217 5.3 Jo	246 5.8 Tf	249 11.7 Pt	239 10.4 Ch	190926	245[12.1 Pt
222 5.5 Tf	246 6.0 Wd	259 11.7 Pt	252 11.2 B	237 9.7 Pt	246[12.1 L
222 5.8 Lj	246 5.9 Lj	RX LYR	SU SGR	247 9.3 Pt	247[12.5 L
223 5.7 Lj	246 5.9 L	185032	*185722*	RS LYR	259[11.0 Pt
223 5.8 Bc	247 6.0 Bg	237 11.8 Pt	207 8.9 Ht	190933a	261[11.0 Pt
224 5.7 Lj	247 6.1 Wd	238 12.2 Br	212 8.9 Ht	239 13.9 L	TY SGR
225 5.7 Lj	248 6.0 Wd	239 11.8 Ch	RT LYR	242[13.4 Ch	*191124*
226 5.4 L	248 5.8 GD	S CRA	185737	266[13.4 Bw	209[13.0 Bl
228 5.8 Lj	248 6.2 Ma	*185437a*	235 10.0 L	RU LYR	S SGR
229 5.8 Lj	248 6.0 Lj	161 12.0 Sl	239 9.9 Br	190941	*191319a*
229 5.5 Tf	248 6.0 Sl	171 12.2 Sl	239 10.3 Ch	242 13.4 Ch	207 11.1 En
229 5.3 Be	248 5.9 Pt	183 12.1 Sl	R AQL	U DRA	207 10.6 Ht
231 6.0 Bc	249 5.9 Pt	186 11.6 Sl	190108	190967	210 10.7 Bl
231 5.5 Ch	250 5.9 Pt	204 12.1 Sl	219 11.2 Jo	237 10.9 Pt	212 10.8 Ht
231 5.3 Jo	250 6.0 Me	207 11.7 Ht	237 11.1 Pt	239 10.1 L	214 11.0 En
231 5.7 Pt	250 6.0 Lj	207 11.9 En	239 11.0 Jo	240 9.8 Fd	237 12.1 Pt
232 5.8 Pt	250 6.0 Wd	209 12.0 Bl	240 11.1 Pc	242 10.0 Ch	239 12.7 L
232 5.9 Lj	250 6.1 Bc	209 12.5 Sl	243 10.9 Ch	262 10.0 Sf	240 12.2 Ch
233 5.8 Bc	250 5.9 Tf	212 11.6 Ht	252 10.0 B	W AQL	Z SGR
233 6.0 Lj	251 6.0 Pt	214 11.9 En	252 10.8 Ah	*191007*	*191321*
234 6.0 Bc	253 6.3 Wd	235 12.2 Sl	V LYR	242 13.0 Ch	207 12.1 En
235 5.5 Tf	253 6.0 Pt	240 12.1 Sl	190529a	247 12.9 Bw	SW SGR
235 6.0 Lj	254 6.1 Bg	248 11.9 Sl	237 11.5 Pt	T SGR	*191331*
235 5.2 L	256 6.2 Wd	ST SGR	239 11.8 Br	*191017*	208 9.9 En
236 5.9 Lj	257 6.2 Al	*185512a*	242 12.0 Ch	237 12.0 Pt	210 9.9 Bl
236 5.7 Pt	258 6.4 GD	238 8.0 L	250 12.0 Md	239 11.6 L	

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
TZ CYG	R CYG	χ CYG	NOV CYG	R TEL	SX CYG
191350	193449	194632	195553	*200747*	201130
237 10.8 Pt	247 8.4 Fd	210 6.9 Hr	245[12.2 Pt	208 13.0 En	246 14.3 L
U LYR	247 8.2 Ch	217 6.0 Jo	247[12.9 Ch	210 14.0 Bl	266[13.1 Bw
191637	247 8.2 Ma	225 6.9 Hr	249[12.2 Pt	RU AQL	RT SGR
219 9.7 Jo	248 9.0 Hr	228 7.0 Hr	261[12.2 Pt	200812	*201139*
230 9.8 Jo	248 8.8 Wd	230 7.0 Hr	RR TEL	238 10.2 BE	210 7.5 Bl
237 9.1 Pt	250 9.0 Hr	230 6.3 Jo	*195656*	246 10.2 L	WX CYG
238 9.9 Jo	252 8.9 Ah	231 7.1 Hr	207 12.6 Ht	247 10.2 Ma	201437b
238 10.5 Fd	253 8.4 Fd	231 6.7 Pt	212 12.6 Ht	248 10.2 Ch	219 10.8 Jo
242 10.4 Jo	256 8.7 B	233 7.1 Ah	214 12.5 En	259 10.1 BE	238 11.7 Jo
247 10.6 Fd	256 8.8 Wd	234 7.1 Ah	Z CYG	W CAP	238 11.9 Pt
262 11.0 Fd	260 9.0 Wd	238 7.3 Bc	195849	*200822*	240 11.4 Al
AF CYG	261 9.0 Wd	238 7.1 Br	231 12.5 Pt	210 13.2 Bl	243 11.8 Jo
192745	262 9.3 Fd	238 6.7 Jo	246 14.2 L	Z AQL	246 11.5 L
234 7.2 Ah	263 9.1 Wd	239 7.4 Hr	247 13.3 Ch	*200906*	247 11.7 Ch
252 8.0 Ah	RV AQL	240 7.5 Hr	S TEL	238 13.1 Pt	253 11.6 Al
TY CYG	193509	241 7.7 Bg	*195855*	243 12.4 Bw	262 11.7 Al
192928	231 10.6 Pt	241 7.7 Me	208 12.9 En	246 11.9 B	262 12.3 Md
238 12.9 Br	244 10.3 L	241 7.4 Hr	210 13.0 Bl	248 12.0 Ch	V SGE
239 13.0 Ch	T PAV	242 7.4 Ch	212 12.6 Ht	251 11.5 Bw	201520
244 14.0 L	*193072*	242 6.8 Jo	214 12.9 En	R SGE	224 11.8 L
RT AQL	207 10.1 Ht	246 7.5 Wd	SY AQL	200916	234 11.1 L
193311	207 9.9 En	247 7.6 Bg	200212	230 9.0 Jo	235 11.2 L
237 9.0 Pt	210 9.7 Bl	247 7.2 Ma	246 12.9 Be	236 9.6 Me	239 10.9 L
238 9.1 BE	212 9.5 Ht	248 7.5 Wd	247 13.4 L	239 9.1 Jo	239 11.6 Br
242 9.5 Ch	214 9.4 En	248 7.7 Hr	261 12.0 Md	240 8.6 Jo	242 11.1 L
244 9.3 L	219 9.1 Ht	250 7.6 Hr	BU CYG	241 9.7 Me	246 10.7 L
247 9.1 Ma	RT CYG	250 7.7 Me	200250	250 9.0 Me	247 11.1 L
259 9.3 BE	194048	252 7.5 Ah	236[12.8 Lj	258 8.6 Me	U CYG
R CYG	219 10.5 Jo	254 7.8 Bg	250[12.7 Lj	260 8.7 Me	201647
193449	230 11.5 Jo	256 7.9 B	S CYG	RS CYG	219 8.2 Jo
121 9.6 Hr	231 11.7 Pt	260 7.6 Wd	200357	200938	223 8.0 Jo
126 9.1 Hr	240 11.8 Al	263 8.6 Wd	238[13.8 Br	214 7.6 Ch	223 9.2 Ch
133 8.9 Hr	246 11.9 Al	S PAV	246 14.5 L	219 7.3 Jo	236 8.3 Fd
145 8.4 Hr	247 11.5 Ch	*194659*	247[13.8 Br	235 7.5 L	238 8.2 Fd
160 8.0 Hr	257 11.8 Al	207 7.8 En	247[13.3 Ch	238 7.4 Pt	238 8.0 Wd
194 7.2 Hr	TU CYG	214 7.7 En	R CAP	238 7.3 Jo	238 7.8 Jo
196 7.1 Hr	194348	RR SGR	*200514*	240 7.2 Al	238 7.9 Pt
210 8.1 Hr	238[13.6 Br	*194929*	238 10.4 Pt	243 7.0 Jo	242 7.8 Jo
215 8.2 Hr	240[11.5 Pc	208 12.1 En	239 11.0 L	246 7.5 L	242 7.7 Al
219 7.7 Jo	246[14.7 L	210 12.0 Bl	S AQL	246 7.6 Wd	246 7.9 Wd
226 8.3 Hr	247[12.2 Ma	214 12.2 En	200715a	247 7.2 Ch	247 7.9 Fd
228 8.4 Hr	X AQL	RU SGR	230 10.0 Jo	248 7.5 Wd	247 7.8 Ch
230 8.4 Hr	194604	*195142*	232 10.3 Be	248 7.5 GD	247 8.3 Me
230 7.9 Jo	229 9.6 Tf	207 13.0 Ht	236 9.9 Me	253 7.2 Al	247 7.8 Al
231 8.3 Pt	231 8.8 Pt	207 12.3 En	239 9.9 Jo	256 8.2 Wd	248 7.8 Wd
234 8.4 Hr	235 9.0 Jo	210 12.7 Bl	241 9.9 Me	260 7.6 Wd	253 8.5 Fd
234 8.0 Ah	235 9.0 Tf	212 13.2 Ht	242 9.6 Jo	262 7.1 Al	256 8.0 Wd
236 8.0 Fd	239 8.4 Jo	214 12.8 En	246 9.0 Be	263 7.6 Wd	260 8.0 Wd
238 7.8 Fd	240 8.2 Pc	RR AQL	248 9.4 Ch	R DEL	261 8.0 Wd
238 8.3 Wd	241 8.5 Tf	*195202*	250 9.4 Me	201008	262 8.4 Fd
238 8.3 Br	242 8.4 Jo	246 13.8 L	258 9.3 Me	238 12.7 Pt	262 7.7 Al
238 8.0 Jo	244 8.3 L	RS AQL	RW AQL	239 13.2 Br	262 7.6 Md
239 8.7 Hr	246 8.3 B	*195308*	200715b	246 12.5 L	262 8.4 Sf
240 8.0 Pc	246 8.4 By	243 13.0 Ch	230 9.0 Jo	RT CAP	263 7.8 Wd
240 8.8 Hr	246 8.4 Tf	246 13.1 L	238 9.2 Pt	*201121*	U MIC
241 8.9 Hr	262 8.4 Sf	NOV CYG	239 9.2 Jo	238 6.3 Pt	*202240*
242 8.5 Jo		195553	242 9.5 Jo		210 11.3 Bl
246 8.8 Wd		237[12.2 Pt			

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RW CYG	Y AQR	X DEL	T CEP	RV CYG	S LAC
202539	*203005*	205017	210868	213973	222439
241 8.6 Me	230 12.0 Jo	240 13.5 Br	240 7.9 Hr	238 6.4 Pt	250 11.8 Al
250 8.5 Me	238 11.7 Jo	246 13.2 L	240 7.1 Fd	RR PEG	262 11.5 Al
Z DEL	238 12.0 Pt	R VUL	242 7.3 Jo	214024	262 12.0 Md
202817	240 12.6 Br	205923a	242 7.0 Ch	235 11.3 Br	R IND
238 9.7 Pt	243 11.5 Jo	219 9.8 Jo	243 7.9 Hr	238 11.2 Pt	*222867*
246 10.9 L	246 12.2 B	238 11.0 Jo	246 7.0 Jo	248 9.1 Ch	208 9.1 Ht
247 11.0 BE	T DEL	238 10.6 Pt	246 6.7 Wd	R GRU	210 9.3 Bl
247 10.7 Ma	204016	242 11.8 Jo	248 7.3 Wd	*214247*	T TUC
259 11.4 BE	232[13.0 Be	247 11.9 Ch	249 7.8 Hr	207[12.9 En	*223462*
262 12.0 Md	240[12.5 Fd	V CAP	252 7.5 Ah	210[13.7 Bl	207 9.2 Ht
ST CYG	246[14.3 L	*210124*	253 7.9 Hr	212[12.9 Ht	208 8.7 En
202954	247[14.3 Br	210[13.2 Bl	254 7.5 Gy	V PEG	212 9.4 Ht
237 12.5 BE	U DEL	TW CYG	256 7.1 Wd	215605	217 9.3 En
238 12.8 Pt	204017	210129	260 7.0 Wd	247 14.7 L	219 9.2 Ht
239 12.6 Br	222 6.6 Tf	235 11.4 Br	261 7.6 Gy	U AQR	R LAC
246 13.1 L	229 6.9 Tf	246 11.3 L	263 6.8 Wd	*215717*	223841
247 12.9 Ch	235 7.0 Tf	247 11.8 Ch	RR AQR	235[14.5 L	229 9.9 L
247 12.9 BE	241 7.0 Tf	247 11.4 BE	*210903*	RT PEG	235 9.7 Br
V VUL	246 7.0 Tf	X CAP	235 10.1 L	215934	238 10.0 Pt
203226	V AQR	*210221*	238 9.6 Pt	230 10.6 L	242 10.1 Sf
238 8.7 Pt	204102	210 13.2 Bl	Y PAV	RZ PEG	247 9.6 Ch
R MIC	238 8.3 Pt	X CEP	*211570*	220133b	247 10.2 L
203429	239 8.4 L	210382	207 6.4 Ht	238 12.5 Pt	247 10.2 Sf
210 13.1 Bl	248 8.4 Md	238 12.5 Br	212 6.5 Ht	247 13.2 L	261 10.6 Sf
Y DEL	262 8.5 Md	239 12.4 L	219 6.5 Ht	T PEG	R WPEG
203611	W AQR	253 12.9 Al	X PEG	220412	225914
239 11.5 Br	*204104*	RS AQR	211614	235 14.0 Br	235 12.3 Br
246 10.9 L	239 11.8 L	*210504*	236 12.0 Br	246 14.3 L	238 12.0 Pt
247 10.9 BE	240 11.3 Br	236 12.5 Br	238 12.0 Pt	Y PEG	238 12.0 L
247 10.7 Ma	U CAP	238 12.4 Pt	246 13.1 L	220613	238 12.0 Fd
S DEL	*204215*	246 12.2 L	T CAP	235 12.9 Br	243 11.7 B
203816	210 13.7 Bl	246 14.1 B	*211615*	238 12.6 Pt	247 11.4 Ch
222 9.2 Lj	246 14.0 B	Z CAP	210[13.3 Bl	247 11.9 L	247 11.5 BE
224 9.2 Lj	V DEL	*210516*	S MIC	RS PEG	247 11.3 Ma
228 9.2 Lj	204318	238 10.6 Pt	*212030*	220714	248 11.4 Sz
232 9.6 Lj	239 11.8 L	R EQU	207[12.4 En	235 11.1 Br	269 10.4 Ma
236 9.9 Lj	240 11.7 Br	210812	210[13.4 Bl	238 11.8 Pt	R PEG
238 10.1 Lj	247 12.2 Br	230 10.8 BL	Y CAP	242 11.6 L	230110
238 9.2 Pt	248 12.6 Ma	236 10.2 Br	*212814*	T GRU	234 9.1 Ah
244 10.3 Lj	T AQR	238 10.1 Pt	210 9.9 Bl	*221038*	236 9.1 Br
246 10.3 Lj	*204405*	240 9.2 Fd	239 11.2 L	208 10.1 En	238 9.4 Pt
250 10.5 Lj	216 7.4 Jo	246 9.2 L	W CYG	217 9.2 En	247 9.0 Ch
262 10.6 Md	232 8.4 Jo	247 9.0 Ma	213244	S GRU	247 9.6 Sf
V CYG	238 8.6 Jo	262 9.0 Md	224 6.3 L	*221948*	252 9.5 Ah
203847	238 8.3 Pt	T CEP	236 5.9 L	207 9.7 Ht	261 9.7 Sf
223 9.2 Ch	240 9.1 Hr	210868	247 5.9 L	207 9.6 En	262 9.9 Gy
223 8.0 Jo	241 9.3 Hr	210 8.5 Hr	S CEP	208 9.3 En	UZ CEP
238 8.3 Jo	242 8.6 Jo	219 7.1 Jo	213678	212 9.5 Ht	230470
238 8.5 Pt	RZ CYG	225 8.0 Hr	238 8.8 Pt	217 9.6 En	215[13.5 By
240 9.2 Pc	204846	226 8.0 Hr	240 9.4 Fd	219 9.7 Ht	V CAS
242 8.5 Jo	238 11.5 Pt	227 8.0 Hr	241 9.6 Hr	RV PEG	230759
246 8.3 L	240 11.0 Fd	228 8.0 Hr	248 9.5 Hr	222129	222 9.5 Lj
247 8.3 Ch	S IND	231 7.9 Hr	RU CYG	247 13.8 L	224 9.4 Lj
247 8.2 Ma	*204954*	231 7.0 Jo	213753	S LAC	228 9.4 Lj
250 9.6 Hr	207 8.1 Ht	233 7.9 Hr	238 7.9 Pt	222439	232 9.1 Lj
256 8.6 B	210 7.6 Bl	234 7.4 Ah	250 8.2 Bw	230 12.0 L	234 8.4 Ah
269 8.4 Ma	212 8.0 Ht	238 7.3 Pt	252 8.2 Ah	238 11.9 Pt	236 9.0 Lj
	219 8.7 Ht	240 6.9 Al	266 8.4 Bw	247 11.7 L	238 8.0 Pt

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J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
V CAS			**S PEG**			**ST AND**			**R AQR**			**RR CAS**			**Z PEG**		
230759			231508			233335			*233815*			235053			235525		
246	8.2	Lj	235	12.9	Br	229	10.0	Lj	210	8.6	Bl	244	[13.3	B	235	12.3	Br
248	7.2	Ch	238	13.2	Pt	232	10.2	Lj	211	8.3	Ht	250	[13.0	Al	236	12.4	Lj
250	8.2	Lj	238	12.9	L	235	10.2	B	217	8.8	Jo	262	[13.1	Bn	238	12.0	Pt
252	7.6	Ah	243	13.0	B	236	10.6	Lj	219	8.4	Ht	**V CET**			238	12.9	L
253	7.9	B	248	12.8	Ch	238	10.1	Pt	230	8.5	Jo	*235209*			246	12.8	Lj
258	7.4	Me	**RY CEP**			238	10.7	Fd	230	8.5	L	210	[13.6	Bl	250	12.9	Lj
262	7.5	Sf	231878			239	10.6	Al	235	8.9	Tf	236	13.4	Br	**W CET**		
W PEG			215	[13.4	By	240	10.6	Al	238	8.4	Jo	247	12.9	L	*235715*		
231425			**V PHE**			243	10.7	BL	238	8.5	Pt	**R TUC**			247	8.8	Fd
219	9.0	Jo	*232746*			244	10.7	B	239	8.5	Hr	*235265*			**Y CAS**		
221	9.4	Be	208	11.3	En	244	10.5	Lj	240	8.5	Hr	208	[12.9	En	235855		
230	9.4	L	211	11.6	Ht	246	10.7	Lj	241	9.4	Hr	211	[13.0	Ht	235	14.6	Br
232	9.4	Jo	217	12.0	En	246	11.0	BL	241	8.2	Tf	217	[12.9	En	248	14.6	L
240	9.3	Fd	**Z AND**			247	10.7	Al	246	8.4	Be	**R CAS**			**SV AND**		
240	10.2	Al	232848			248	11.0	BL	246	8.1	Tf	235350			235939		
242	9.6	Jo	238	10.3	Pt	250	10.9	Lj	247	8.6	Ma	235	12.0	Br	235	12.5	Br
246	9.8	Jo	240	10.1	Fd	253	10.9	BL	247	8.1	L	243	11.3	B	238	12.5	Pt
246	9.4	L	**ST AND**			260	11.2	L	247	8.2	Ch	246	10.5	Wd	243	13.2	B
246	10.0	Be	233335			261	10.9	Al	247	8.4	Me	248	10.6	Wd	243	12.8	Bw
248	9.6	Ch	222	9.8	Lj	263	11.3	BL	261	8.2	Al	248	12.1	Ch			
252	10.8	Bw	224	10.0	Lj				**Z CAS**			263	10.6	Wd			
261	10.0	Al							233956								
266	11.0	Bw							238	14.4	L						

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX ANDROMEDAE—							074922 U GEMINORUM—						
	6229.6	13.1	L	6240.7	13.5	Br		6224.6	[13.7	L	6241.9	[12.3	Pt
	6232.7	13.0	Pt	6240.9	13.0	Pt		6226.6	[13.3	L	6242.6	13.8	L
	6234.4	11.1	L	6242.3	13.3	L		6228.6	[12.4	L	6243.6	14.1	L
	6235.4	11.1	L	6242.6	13.3	L		6230.6	[13.3	L	6244.6	14.0	L
	6235.7	11.4	Br	6243.6	13.1	L		6235.6	[13.3	L	6245.9	[12.4	Pt
	6236.6	11.7	L	6244.2	11.6	Ch		6236.6	[13.3	L	6246.6	14.1	L
	6236.7	11.7	Pt	6244.6	10.6	L		6238.6	14.0	L	6246.9	[13.3	Pt
	6236.9	11.6	Br	6245.7	11.5	Pt		6239.6	[13.7	L	6247.6	14.0	L
	6237.6	12.5	L	6246.2	11.3	L		6240.6	14.1	L			
	6237.7	12.0	Pt	6246.6	11.4	L	081473 Z CAMELOPARDALIS—						
	6238.6	13.4	L	6246.9	11.1	Pt		6224.6	10.9	L	6238.6	13.0	L
	6238.8	13.4	Br	6247.4	11.8	L		6226.6	10.9	L	6239.3	13.0	L
	6239.4	13.0	L	6247.6	12.0	L		6228.6	11.3	L	6239.6	12.8	L
	6239.6	13.1	L	6247.7	12.5	Pt		6229.6	11.5	L	6240.6	11.5	L
	6239.8	13.4	Br	6248.7	12.5	Pt		6230.6	11.7	L	6242.3	10.8	L
	6240.6	13.3	L	6249.7	13.0	Pt		6234.4	12.2	L	6242.6	11.0	L
060547 SS AURIGAE—								6235.3	12.7	L	6243.6	11.3	L
	6224.6	[14.8	L	6240.9	11.4	Pt		6236.6	12.9	L	6244.6	11.5	L
	6226.6	[13.9	L	6241.9	12.4	Pt		6237.6	12.9	L	6247.3	12.0	L
	6228.6	[13.9	L	6242.6	12.1	L		6238.4	13.0	L			
	6229.6	[13.9	L	6243.6	13.0	L	094512 X LEONIS—						
	6230.6	[13.9	L	6244.6	13.8	L		6239.7	[11.8	L	6244.6	[13.8	L
	6235.6	[13.9	L	6245.9	[12.6	Pt		6240.7	[12.0	L	6246.6	[13.8	L
	6236.9	[13.8	Br	6246.6	14.3	L		6242.6	[12.3	L	6247.6	[13.8	L
	6237.6	10.8	L	6246.9	[13.0	Pt		6243.6	[12.3	L			
	6237.9	10.8	Pt	6247.6	14.4	L	202946 SZ CYGNI—						
	6238.6	10.9	L	6247.8	[13.5	Pt		6231.7	9.5	Pt	6239.7	9.4	Pt
	6238.7	11.0	Pt	6248.7	[12.6	Pt		6232.7	8.8	Pt	6240.9	9.6	Pt
	6239.6	10.9	L	6249.7	[12.0	Pt		6236.7	9.0	Pt	6241.9	9.6	Pt
	6239.7	11.5	Pt	6251.7	[11.0	Pt		6237.7	9.1	Pt	6242.7	9.5	Pt
	6240.6	11.0	L	6254.8	[11.5	Pt		6238.7	9.1	Pt	6243.7	9.5	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING OCTOBER, 1930.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
202946 SZ CYGNI—				
	6245.7	9.5 Pt	6251.7	8.8 Pt
	6246.9	9.0 Pt	6253.7	9.3 Pt
	6247.8	8.8 Pt	6254.8	9.4 Pt
	6248.7	9.0 Pt	6259.7	9.5 Pt
	6249.7	9.0 Pt	6261.7	9.5 Pt
	6250.7	9.0 Pt		
213843 SS CYGNI—				
	6180.7	9.9 Jn	6232.3	9.2 Lj
	6188.6	8.6 Jn	6232.3	9.1 L
	6189.6	9.3 Jn	6232.7	9.2 Pt
	6219.7	11.8 Jo	6233.3	8.9 L
	6221.3	12.0 Be	6233.4	8.8 Ah
	6222.3	11.9 Lj	6234.3	8.5 Ah
	6223.1	11.6 Ch	6234.3	8.8 L
	6223.3	11.9 Lj	6234.6	8.6 Bc
	6223.7	11.8 Jo	6235.3	8.8 L
	6224.3	11.9 Lj	6235.5	8.5 Sf
	6224.6	12.2 L	6235.7	8.8 Br
	6225.3	11.9 Lj	6236.3	9.0 L
	6226.3	11.6 L	6236.6	9.0 L
	6228.3	11.4 L	6236.6	9.2 L
	6228.3	11.4 Lj	6236.6	9.0 Bc
	6229.3	10.3 Lj	6236.6	9.0 Me
	6229.3	9.8 L	6236.7	8.8 Br
	6229.4	10.2 Lj	6236.7	9.2 Pt
	6229.6	10.1 L	6236.8	9.1 Fd
	6230.3	9.7 L	6237.3	9.0 L
	6230.3	10.1 Lj	6237.6	9.5 L
	6230.6	9.6 L	6237.6	9.3 Me
	6231.3	9.0 L	6237.7	9.5 Pt
	6231.6	9.3 Bc	6238.3	9.2 L
	6231.7	9.5 Pt	6238.4	9.2 L
213843 SS CYGNI—				
	6238.6	9.2 Al	6246.3	11.7 L
	6238.6	9.5 L	6246.5	10.9 Al
	6238.6	9.5 Bc	6246.8	11.8 Pt
	6238.7	9.8 Pt	6247.2	11.3 L
	6238.7	9.7 Br	6247.3	11.8 L
	6238.8	9.5 Fd	6247.3	11.7 Ch
	6239.4	9.7 L	6247.6	11.7 Al
	6239.6	9.7 L	6247.7	11.8 Pt
	6239.6	9.8 Al	6247.7	11.9 Br
	6239.7	9.6 Pc	6247.8	12.0 Fd
	6239.7	10.1 Br	6247.8	11.9 Ma
	6239.9	10.3 Pt	6248.7	11.8 Pt
	6240.6	9.6 Me	6249.6	12.0 Bc
	6240.6	10.4 Fd	6249.7	11.8 Pt
	6240.6	10.3 Al	6250.3	11.9 L
	6240.6	10.0 L	6250.6	11.9 Al
	6240.6	10.2 Jo	6250.7	11.7 Pt
	6240.7	10.1 Pc	6251.7	11.7 Pt
	6240.7	10.3 Br	6252.4	12.0 Ah
	6240.9	10.2 Pt	6253.6	11.9 Al
	6241.6	10.5 Me	6253.7	11.7 Pt
	6241.7	11.2 Pt	6254.8	11.7 Pt
	6242.3	10.6 L	6259.7	11.8 Pt
	6242.5	11.0 Sf	6261.6	9.5 Al
	6242.6	10.4 Al	6261.6	9.6 Pc
	6242.6	10.9 L	6261.7	10.2 Pt
	6242.7	10.7 Jo	6262.6	9.0 Pc
	6242.7	11.5 Pt	6262.6	8.9 Al
	6243.7	11.6 Pt	6262.6	8.7 Fd
	6244.3	10.9 L	6266.7	8.3 Ma
	6244.3	11.5 L	6268.7	8.6 Ma
	6245.9	11.8 Pt	6269.8	8.7 Ma
	6246.2	11.3 L		

SUMMARY FOR OCTOBER, 1930.

Observer	Initial	Vars.	Observations
Ahnert	Ah	36	58
Allen, P. R.	Al	19	44
Baldwin	Bl	90	93
Beloit Coll.	BE	7	10
Benini	Be	10	23
Beyer	By	9	19
Bigelow	Bw	24	31
Boutell	BL	14	63
Bouton	B	48	49
Brocchi	Br	86	102
Brown, A. N.	Bn	4	7
Buckstaff	Bc	7	15
Bunting	Bg	2	7
Chandra	Ch	98	108
Ensor	En	73	149
Ferris	Fe	2	2
Ford	Fd	42	74
Godfrey Club	GD	8	30
Gregory	Gy	11	19
Houghton	Ht	62	125
Huruhata	Hr	25	180
Johnston	Jn	2	5
Jones	Jo	72	250
Lacchini	L	177	369
Leiner	Lj	15	115
Marsh	Ma	33	40
McLeod	Mc	12	21
Meek	Me	19	36
Millard	Md	13	14
Monnig	Mg	14	16
Peltier	Pt	180	333
Proctor	Pc	19	40
Shinkfield	Sl	23	145
Shultz	Sz	6	9
Smith, F. W.	Sf	13	22
Taffara	Tf	10	32
Webb	Wd	15	75
Totals		37	416 2710

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS FOR THE YEAR ENDING OCTOBER 31, 1930.

Observer	Initial	November	December	January	February	March	April	May-June	July-Aug.	September	October	Totals
Ahnert	Ah	96	215	204	300	365	119	269	285	262	58	2173
Allen, P. R.	Al	21	27	13	3	6	7	5	..	32	44	158
Ancarani	An	256	27	..	..	..	..	..	..	..	..	283
Baldwin	Bl	..	204	148	150	182	304	236	136	161	93	1614
Benini	Be	92	..	..	15	..	..	6	12	46	23	194
Beloit College	BE	..	..	..	..	..	4	12	..	..	10	26
Beyer	By	..	..	..	..	26	..	..	..	..	19	45
Bigelow	Bw	..	43	7	..	10	7	38	33	..	31	169
Boutell	BL	45	58	83	64	74	46	162	55	..	63	650
Bouton	B	55	49	105	40	70	41	113	..	..	49	522
Brocchi	Br	45	18	6	54	51	55	75	110	46	102	562
Brown, A. N.	Bn	5	2	5	10	12	14	8	6	7	7	76
Buckstaff	Bc	14	8	6	..	5	11	14	122	..	15	195
Bunting	Bg	..	..	..	..	..	..	..	..	21	7	28
Chandra	Ch	142	180	158	159	189	130	148	186	96	108	1496
Darling	Dg	..	..	..	..	..	..	..	25	..	..	25
Dartayet	Dr	..	274	181	216	..	156	124	255	..	..	1206
Dawson	Dw	..	35	..	..	..	..	..	..	..	..	35
Ensor	En	53	..	22	79	47	85	184	257	131	129	967
Ford	Fd	88	18	13	31	24	56	176	224	22	74	726
Gaebler	Gb	7	5	4	1	4	8	10	32	..	..	71
Gallanti	Gt	198	..	..	3	..	..	..	..	..	..	201
Godfrey Club	GD	..	..	..	..	..	..	..	..	45	30	75
Gregory	Gy	..	..	7	..	7	1	18	20	19	19	97
Haas	HS	..	..	..	..	..	17	57	37	..	..	111
Houghton	Ht	162	114	80	128	174	90	305	242	26	125	1446
Huruhata	Hr	..	..	..	..	..	..	..	..	..	180	180
Jones	Jo	82	40	20	38	65	144	262	251	192	250	1344
Kanda	Kd	..	100	..	..	..	63	..	..	..	..	163
Kohl	Kl	34	..	11	..	19	..	3	..	..	..	67
Lacchini	L	593	325	656	358	225	370	588	784	278	369	4546
Leiner	Lj	82	84	77	49	50	46	128	208	149	115	986
Logan	Lg	12	19	23	23	9	10	9	32	..	..	137
Marsh	Ma	88	8	22	..	36	31	105	73	58	40	461
McBride	Mb	19	24	..	..	..	..	..	..	..	..	43
McLeod	Mc	..	..	..	..	..	..	4	8	17	21	50
Meek	Me	..	..	..	..	..	..	8	..	62	36	104
Millard	Md	38	11	..	4	3	..	22	28	8	14	128
Monnig	Mg	3	..	..	6	..	..	4	60	..	16	89
Nakamura	Nk	..	..	..	..	39	..	..	..	..	..	39
Nizamiah Obs.	Nz	..	..	242	..	83	137	46	..	..	..	508
Peltier	Pt	298	248	208	249	259	286	520	497	256	333	3154
Proctor	Pc	..	..	..	..	..	..	..	..	..	40	40
Shinkfield	Sl	..	..	..	..	..	..	..	..	..	145	145
Smith, F. W.	Sf	14	21	17	14	19	25	84	27	21	22	264
Smith, W. H.	Sm	..	..	..	..	74	20	78	146	..	..	318
Swanson	Sw	8	..	..	..	..	..	12	..	..	..	20
Taffara	Tf	17	57	51	34	15	24	10	25	28	32	293
Webb	Wd	15	3	6	17	24	36	78	55	44	75	353
27 Others	..	17	23	13	11	7	53	53	20	16	16	229
Totals	76	2595	2250	2388	2056	2174	2402	3918	4287	2143	2710	26823

SUMMARY OF ANNUAL REPORTS, 1912-1930.

Year	Observations	Variables	Observers
1912	6,180	175	19
1913	12,914	200	20
1914	14,506	255	28
1915	14,724	282	29
1916	11,261	290	30
1917	15,788	332	43
1918	16,112	380	34
1919	8,710	352	53
1920	9,099	399	69
1921	15,513	386	77
1922	16,994	372	72
1923	17,745	441	68
1924	19,484	450	70
1925	23,375	439	68
1926	17,990	434	74
1927	17,600	470	75
1928	23,144	500	78
1929	27,218	510	61
1930	26,823	500	76
Totals	315,080	530	375

plotted results of the Summary of Annual Reports confirms our impression of steady progress and further advancement in our special line of endeavor. More observers are still needed if we are to secure sufficiently well observed light curves for all the variables upon our list, especially those observers having large instruments at their disposal. The formation of local observing centers is to be encouraged, particularly when we have a fine instrument there located and a well trained observer to supervise such activity.

LEON CAMPBELL, Recording Secretary.

November 12, 1930.

COMET NOTES

By G. VAN BIESBROECK.

COMET NAKAMURA. (?) A telegram under date of November 20 was sent out by the Central Bureau in Copenhagen, via Harvard, announcing the discovery of a comet by Nakamura, observed by Sibata as follows:

Nov. 13.5764 U.T. $\alpha = 3^h\ 40^m\ 41^s.5$ $\delta = +18^\circ\ 53'\ 25''$ 13^M

This position was supplemented by a parabolic orbit:

Perihelion passage	1930 Aug. 21.37
Perihelion to node	40° 19′
Node	231 26
Inclination	8 7
Perihelion distance	0.203 Astronomical units

and with the ephemeris:

1930	α h m s	δ ° ′	Brightness
Nov. 16	3 33 32	+18 23	1.00
20	22 6	17 35	
24	13 32	16 52	0.69

According to additional information through the press this object would be the return of a comet found by K. Nakamura at Kyoto (Japan) in 1922.

The sky was brilliantly clear at the Yerkes Observatory on November 20 and the search for the object was started at once. Visual scouting around the ephemeris place revealed several faint nebulae but no cometary object. Next the search was taken up by photography with the same negative result. With the means employed any comet as bright as 16th magnitude would have been noticed easily. There seems to have been some misinterpretation or else some unexplainable error in the transmission of the information.

In 1922 K. Nakamura picked up a comet of 13th magnitude which he thought was a return of Perrine's periodic comet of 1896. He had no means of determining accurate positions but reported that he had seen the comet on three nights and that the motion nearly correspond to one of two very uncertain ephemerides that had been published for this return. Nevertheless, nobody succeeded in confirming the observation and the object, first designated as 1922 *e*, was dropped as questionable. The present finding can of course not have any relation with the 1922 object, the more so since Professor Issei Yamamoto, director of the Kyoto Observatory, has wired a parabolic orbit. Further details have to be awaited from the source of discovery before an explanation of our failure in locating the object subsequently can be given.

So far as is known at present no comets are visible in ordinary instruments at this time. Observations are however continued, with more powerful telescopes, of four inconspicuous objects.

In the evening sky Periodic Comet Tempel II is slowly losing in brightness as expected after its perihelion passage on October 5. It still shows a little diffuse tail about 2′ long in position angle 320° but the brightness was reduced to that of a star of the thirteenth magnitude according to a plate obtained by the writer on November 18. Although the southern declination of —28° makes the observations difficult for northern stations, the measures will probably be continued through the month of December when the altitude becomes more favorable.

Comet 1930 *b* (Beyer), now reaching its eighth month of visibility, is reduced to a small round nebulosity the brightness of which corresponds to that of a 15^{M} star (Nov. 18). In the beginning of December it comes in conjunction with the sun but on account of its northern declination, in Hercules, it can be followed through the conjunction, after which it will be better placed in the morning sky. The brightness has, however, declined faster than was predicted so that it will soon be extremely faint.

Next there are two Comets discovered in 1927 which can still be observed photographically: Comet 1927 IV (Stearns) was again recorded near the ephemeris position both at Bergedorf (Germany) and at Williams Bay. It appears as a minute round nebula but its brightness has dropped to the 17th magnitude in November. The Comet has now been followed month after month since March, 1927, which gives it a record for duration of visibility.

However, it seems that Comet 1925 II (Schwassmann-Wachmann) also found in 1927 will even beat that record. Its small eccentricity which gives it a unique position among periodic Comets is such that without doubt that Comet will remain visible year after year while it describes its 16 year circle around the sun. Its path, situated entirely between the limits of Jupiter's and Saturn's orbit,*

*See the diagram in Popular Astronomy, **33**, 203 (1928).

differs so little from a circle that relatively small changes in brightness are expected as the object passes from perihelion in 1925 to aphelion in 1933. With the help of new elements computed by T. G. Behrens from observations covering nearly three years up to 1930 January 23 the comet has again been observed at Bergedorf (October 23) and at Williams Bay (October 20 and November 23). It appears a little brighter than Stearn's Comet and its coma is larger. The ephemeris for the coming opposition is given in *Beob. Zirk.*, Nr. 42. The comet will then be high up in the constellation of Gemini but it is accessible only to large telescopes.

Williams Bay, Wisconsin, November 24, 1930.

METEOR NOTES

By CHARLES P. OLIVIER.

These notes have been delayed so that a few words could be said about the return of the Leonids in 1930. While most of our regular A.M.S. observers have not had time to notify us of their success, about 15 letters have come in from points as far off as Cuba, New Mexico, and Wisconsin, to take the extremes in different directions. At Flower Observatory and for a long distance around, hopelessly cloudy weather prevailed until November 19, and even on this night clouds came over at 12:30, when Leo was still low in the sky. No meteors were seen in intermittent watches up to 13 hours, but the sky was hazy. On no other night was any observation whatever possible because of clouds. Reports from elsewhere show, however, that a moderate number of Leonids appeared on November 14 and 15, but the finest shower since 1901 came on November 16—i.e. the morning of November 17 by civil reckoning. According to Professor C. C. Wylie at Iowa City, Iowa, the rate for one observer was 120 per hour shortly before dawn. There were many brilliant meteors with long enduring trains. Many Leonids were also seen by him on the next night.

From the reports at hand we are therefore safe in saying that in 1930 the Leonids gave an excellent display, but from one to two days later than we had any reason to expect. It is quite possible that complete reports may show this was a better shower than in 1901. In any case, our hopes for the years 1932-1934 inclusive have been greatly raised, and plans for extensive observations in every November from now to 1935 should be made by all interested in meteors.

The past month has brought in much material for study from our regular members. The Orionids in October proved to be rather disappointing, as fewer were seen than is usual. Complete reports are not in from all stations. In the rate table will be found information as to their hourly numbers.

To mention a few, the Texas observers have sent in long and interesting reports, McIntosh from New Zealand has derived a fine lot of radiants including many of the Delta Aquarids, and we are glad to have several persons in Tennessee actively coöperating at the present time. The record, so far, for successful work in 1930 by an individual, goes to our member, Gordon W. Ridley of Alameda, California, who joined only about a year ago. The clearness of the atmosphere at his station, and its position so far west of most others, both combine to add to the value of his work. If in states where we now have no observers or only inactive ones, one person in each with the enthusiasm and energy of Ridley could

be found, our results annually would be at least five times as numerous. However, in America, 1930 has been a year of steady if not spectacular progress in meteoric astronomy. The intelligent information on meteors, now given out by the chief newspapers of the country through their science services is one of the best and most hopeful signs for increasing interest in the near future.

DAN F. WAUGH, TOKYO, JAPAN.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
May 18	10:34	11:34	60	1	0.6	1.0	1.7	
29	11:27	12:35	68	8	0.8	7.1	8.8	
July 1	11:24	12:24	60	2	0.7	2.0	2.9	
Aug. 3	12:12	13:22	70	11	0.7	9.4	13.4	
19	8:45	9:45	60	11	0.9	11.0	12.2	
24	11:17	12:42	85	3	0.9	2.1	2.3	
30	10:48	14:24	216	26	0.9	7.2	8.0	
Sept. 2	12:10	13:59	109	7	0.8	3.8	4.8	
30	11:57	12:57	60	1	0.8	1.0	1.2	
Oct. 22	10:25	13:10	165	19	0.9	6.9	7.7	6 Orionids
27	12:50	14:30	100	7	0.6	4.2	7.0	5 Orionids
29	11:09	12:59	110	9	0.9	4.9	5.4	3 Orionids

GORDON W. RIDLEY, ALAMEDA, CALIFORNIA.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Sept. 28	11:22	14:22	180	42	1.0	14.0	14.0	
Oct. 1	13:24	14:04	40	7	0.9	10.5	11.7	
14	13:08	15:08	120	15	0.7	7.5	10.7	2 Orionids
15	13:11	15:15	124	25	0.8	12.1	15.1	4 Orionids
16	13:08	16:08	180	51	0.8	17.0	21.2	11 Orionids
17	13:12	16:12	180	49	0.9	16.3	18.1	18 Orionids
20	13:01	15:31	83	38	0.9	27.5	30.6	11 Orionids
21	13:50	15:25	75	23	0.9	18.4	20.4	7 Orionids
23	13:51	15:31	100	46	1.0	27.6	27.6	21 Orionids
24	13:00	15:00	120	43	1.0	21.5	21.5	14 Orionids
26	12:00	13:22	82	24	1.0	17.5	17.5	4 Orionids
31	13:15	14:40	85	14	1.0	9.9	9.9	1 Orionid

MRS. W. H. EDWARDS, FAIRHOPE, ALABAMA.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Aug. 12	12:00	14:00	120	11	0.4	5.5	13.8	Min. about 13 hrs.
Oct. 21	12:00	14:30	150	56	...	22.4	....	Count only

CARLTON ABERNATHY, CLEARWATER, FLORIDA.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Oct. 30	7:30	9:30	120	16	0.9	8.0	8.9

LINCOLN LA PAZ, BEULAH, COLORADO.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Sept. 18	9:10	11:20	130	17	0.8	7.8	9.8	
	8:36	11:00	144	11	0.7	4.6	6.6	By C. Cross

H. A. BURNS, SPRING VALLEY, NEW YORK.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Aug. 9	8:35	10:35	120	3	0.4	1.5	3.8	2 Perseids
10	10:15	11:20	65	4	0.4	3.7	9.2	3 Perseids
11	8:35	11:00	145	15	0.5	6.2	12.4	10 Perseids

J. E. MCKEE, MT. VERNON, OHIO.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Oct. 18	14:00	15:15	75	15	1.0	12.0	12.0	9 Orionids

S. K. Olweiler, Allentown, Pennsylvania.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Aug.	11	9:00	12:00	180	18	0.3	6.0	20.0
	11	12:00	15:00	180	21	0.3	7.0	23.3

Carl P. Schafer, Nashville, Tennessee.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
Sept.	27	12:25	13:45	80	9	0.9	6.8	7.6	
	29	12:30	14:30	120	16	0.9	8.0	8.9	
	30	12:30	14:30	120	7	0.8	3.5	4.4	
Oct.	15	7:45	9:45	120	6	0.8	3.0	3.8	
	17	7:30	9:00	90	7	0.8	4.7	5.9	
	18	12:30	14:30	120	20	0.8	10.0	12.5	6 Orionids
	24	12:30	14:00	90	18	0.8	12.0	15.0	5 Orionids
	29	13:00	14:00	60	12	0.8	12.0	15.0	2 Orionids

Sterling Bunch, Knoxville, Tennessee.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
June	26	13:43	15:20	97	14	0.6	8.6	14.3	
Oct.	17	12:44	14:50	87	26	0.7	7.9	11.3	10 Orionids; 7 others by Mrs. Bunch

FREDERICK, MARYLAND, GROUP.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
April	20	9:	11:30	..	4	0.5	....	....	by Miss L. B. Allen
	20	13:15	14:15	60	10	0.7	10.0	14.3	by F. F. Marsh
May	2	12:45	14:30	105	10	1.0	5.7	5.7	by F. F. Marsh
Aug.	11	11:00	15:00	240	52	0.4	13.0	32.5	by F. F. Marsh
	11	11:00	13:00	120	27	0.4	13.5	33.8	(1)
	11	12:00	13:30	90	15	0.4	10.0	25.0	(2)
Oct.	21	13:05	15:05	120	16	0.7	8.0	11.4	by F. F. Marsh

(1) by J. H. Apple, Jr., count. (2) by Mrs. E. A. C. Edwards, count.

TEXAS GROUP.

O. E. Monnig, Ft. Worth.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
July	16	10:00	11:30	60	12	1.0	12.0	12.0	
	18	9:50	11:23	68	11	1.0	9.8	9.8	
	20	9:42	12:14	152	10	0.5	4.0	8.0	
	21	9:40	12:01	141	25	1.0	10.6	10.6	
	23	9:39	12:54	182	25	0.8	8.2	10.3	
	24	11:21	13:45	144	27	0.7	11.2	16.0	
	25	10:01	11:03	62	10	...	9.7	....	
	26	9:45	12:50	105	29	1.0	16.6	16.6	
	27	11:42	13:05	81	21	0.7	15.6	22.3	
Aug.	11	8:38	10:46	128	15	0.5	7.0	14.0	
	12	8:36	9:57	81	10	0.5	7.4	14.8	
	13	8:37	10:33	116	5	0.7	2.6	3.7	3 Perseids
	17	9:58	11:58	120	15	0.7	7.5	10.7	3 Perseids
	21	10:34	11:40	66	4	0.7	3.6	5.1	
	22	9:02	10:57	115	4	0.9	2.1	2.3	
Sept.	20	8:25	13:27	302	43	1.0	8.6	8.6	
Oct.	25	10:00	11:50	63	17	1.0	16.2	16.2	2 Orionids

Miss D. H. Hansman, Ft. Worth.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate
July	20	9:25	10:35	70	4	...	3.4	...
	21	9:35	10:45	70	4	...	3.4	...
	22	9:45	11:05	80	6	...	4.5	...
	23	10:20	12:00	100	13	...	7.8	...

ROBERT BROWN, FT. WORTH.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate
May	31	9:58	11:40	102	8	1.0	4.7	4.7
July	27	11:40	13:01	81	13	1.0	9.7	9.7
Aug.	13	8:50	10:08	78	5	0.9	3.8	4.2
	17	9:58	12:00	122	18	0.8	8.9	11.1

BLAKENEY SANDERS.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Sept.	20	8:25	13:21	296	42	1.0	8.5	8.5

J. H. LOGAN.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Aug.	17	9:58	11:45	107	17	0.8	9.6	12.0

R. A. MCINTOSH, AUCKLAND, NEW ZEALAND.

1930		Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Remarks
July	28	15:26	17:10	104	45	0.8	26.0	32.5	
	29	14:45	16:50	125	52	1.0	25.0	25.0	
	30	15:05	16:45	100	39	1.0	23.3	23.3	
	31	15:15	17:16	121	66	1.0	32.7	32.7	
Aug.	1	14:50	17:00	120	63	1.0	31.5	31.5	
Sept.	22	15:05	16:10	65	16	1.0	14.8	14.8	2 others seen

RADIANTS BY R. A. MCINTOSH.

A.M.S. No.	1930	α	δ	Meteors	Wt.	Remarks
	July					
2197	28.70	341°0	—17°0	26	Good	δ Aquarids
2198	29.68	27.0	—11.0	3	Fair	See 2005?
2199	29.68	341.7	—15.7	21	Good	δ Aquarids
2200	29.68	346.0	—26.0	4	Good	See 2205, 2210, 2000, 2008, 2014, 2031, 2041, 2047
2201	29.68	355.0	—40.0	3	Fair	See 2214
2202	29.2c	3.0	—21.5	5	Good	See 2207, 2010, 2097, 2019, 2033
2203	29.2c	10.0	—34.0	7-8	Fair	See 2208
2204	29.2c	308.0	—10.0	8	Fair	
2205	30.68	343.0	—30.0	5	Poor	See 2200, 2210
2206	30.68	344.0	—15.5	14	Good	
2207	31.70	2.5	—19.5	2	Poor	See 2202
2208	31.70	17.0	—35.0	3-6	Poor	See 2203
2209	31.70	37.0	—37.5	3-5	Fair	
2210	31.70	343.0	—29.0	5-6	Fair	See 2200, 2005
2211	31.70	344.5	—15.0	22	Good	δ Aquarids
2212	31.70	346.0	—22.0	5-7	Good	See 2218, D. 262
2213	31.70	351.0	+ 5.0	5-6	Fair	See 2220, 2016, D. 273-3
	August					
2214	1.68	6.0	—41.0	4	Fair	See 2201
2215	1.68	39.0	— 1.5	5	Fair	See 2037
2216	1.68	51.0	—40.0	5	Fair	
2217	1.68	317.0	—22.5	10	Good	See 2028
2218	1.68	345.0	—24.5	7	Good	See 2212
2219	1.68	346.0	—14.0	11	Good	δ Aquarids
2220	1.68	352.0	+ 3.5	4	Good	See 2213, 2016
	September					
2221	22.67	82.0	+15.0	3-5	Fair	
2222	22.67	84.0	+ 4.0	1-3	Fair	See M 61, 62

Flower Observatory, Upper Darby, Pennsylvania, 1930 November 20.

The 1930 Leonid Meteors

Reports from the east indicate that clouds prevented observation of the Leonids at this return, so our preliminary report is made somewhat fuller than would otherwise be the case at this early date. We were favored with reasonably clear weather on the night of the 16th, and the display was much better than anticipated. Observers were located at LaCrosse, Wisconsin; Dubuque, Iowa; Mount Vernon, Iowa; and Iowa City, Iowa. The times are noon to noon reckoning.

November 12, 12:00-18:00. Mr. A. K. Showalter watched occasionally at LaCrosse. There was a light haze over the city and he saw no meteors.

November 13-14. The sky was cloudy at all stations.

November 15, 16:00-18:00. At Iowa City the sky cleared partially after a rain. Messrs. Boyd and Wylie each watched for short periods. Mr. Boyd saw no meteors and Mr. Wylie saw one meteor, probably a Leonid, at the edge of an open space perhaps fifty degrees in diameter.

November 16, 11:45. Professor F. M. McGaw saw a brilliant meteor from Mount Vernon. Father J. A. Theobald, at Dubuque, received telephone calls from persons who had seen a brilliant meteor, perhaps the same one, at that hour.

November 16, 12:00-14:00. At Mount Vernon, Professor McGaw and two students observed fifty meteors between 11:45 and 13:30. The brightest had a path fifty degrees in length. At LaCrosse, the sky was partly cloudy and no observations were attempted. At Iowa City, Messrs. Keeler and Wylie charted meteors from 12:20 to 13:30. Others kept count of the meteors seen and attempted observation of the more conspicuous trains with the telescope. The rate at 12:30 was about thirty per hour for one observer.

November 16, 14:00-16:00. At LaCrosse, Wisconsin, the sky was clear for a time, and Mr. Showalter plotted nineteen meteors in a forty minute period. At Iowa City, Messrs. Boyd and Wylie maintained a count of the number of meteors seen by one observer, alternating on the work to make possible an occasional relaxation. At 14:15, the rate was eighty per hour, and by 15:15 the number had increased to 100 per hour, with an occasional one very brilliant. The most brilliant appeared at 15:43 and illuminated the southern sky like a flash of lightning. Its train was visible for ten minutes, and several others left trains visible for more than a minute. Two reports were received from members of the general public who happened to notice the display. One was accompanied by a sketch showing numerous paths.

November 16, 16:00-18:00. At LaCrosse, passing clouds interfered until 17:00 when the sky cleared, and twenty-nine meteors were then plotted in a period of eighteen minutes. At Dubuque, Father J. A. Theobald and three students charted forty-one Leonids and recorded a total of ninety-nine meteors. Of this number, eight were recorded as not Leonids. Their observations were hampered by passing clouds on three occasions in this period. The most brilliant meteor appeared at 16:08 and left a train visible some minutes. At Iowa City, passing clouds at the beginning of the period caused a drop in the observed rate, to about eighty per hour at 16:15, but the sky cleared again and from 17:00 to dawn the rate was about 120 per hour. A brilliant meteor lighted the eastern sky noticeably at 16:08, probably the same as that observed at Dubuque. The train was visible for about ten minutes, and drifted eastward among the stars an estimated distance of five degrees in four minutes. The rotation of the earth accounts for about one degree, so air currents must have carried it eastward at the rate of about a degree, or at that altitude probably a mile, per minute.

November 16, 18:47. Mrs. Allely, of Randolph, Iowa, reported seeing a bright meteor followed by a bluish trail. She reported it as a daylight meteor, and as sunrise occurred at 19:11, or only twenty-four minutes later, it may be considered such.

November 17, 16:00-18:00. At LaCrosse, there was a light fog, and Mr. Showalter saw only five meteors in a watch of about three hours. At Dubuque, Father Theobald and his group observed twenty-one in the two hours, of which four bright ones were charted. At Iowa City, Messrs. Newby and Schultz charted twenty-three meteors between 16:30 and 17:30. The sky was hazy and the visibility not so good as on the preceding morning.

November 18, 19, 20. No observations.

November 21, 15:00-17:30. At Iowa City the sky was clear and the visibility good. Messrs. Boyd, Newby, and Wylie made independent counts of the number of meteors one observer could see. At 16:30, the average rate for one observer was about eighteen per hour. One typical first magnitude Leonid was seen near the radiant, and about 20 per cent of those observed were recorded as possible Leonids by the observer facing east. Mr. Newby recorded a group of five meteors appearing rather low in the west, all within a few seconds.

Summary. Because of cloudy weather, the results from the 12th to the 15th cannot be considered conclusive, but they are negative as far as they go. The observations at Iowa City with a partly clear sky on Sunday morning cause one to doubt whether the Leonid display had really started. On Monday morning, the display was unquestionably better than anticipated for this year. This is indicated by the relatively high hourly number, especially at Iowa City; by the occasional brilliant meteors leaving trains visible for minutes; by the high proportion of Leonids, ninety-one out of ninety-nine meteors recorded at Dubuque; and by the reports from the general public of the brilliant display and of the daylight meteor.

On November 16, from 15:03 to dawn, the average hourly number for one observer at Iowa City was 105. This includes a period of light clouds. From 17:07 to 17:54½, ninety-eight meteors were counted, or an average of 123 per hour, this being, of course, one observer.

C. C. Wylie.

University of Iowa, November 22, 1930.

Leonids Observed at the Yerkes Observatory

A count of Leonids was made at the Yerkes Observatory on Monday morning, November 17, 1930, and on Tuesday morning, November 18. Cloudy weather prevented earlier observations. The counts were as follows: The times are U.T.

November 17, 6:30-7:30. Observers: Crump, Markowitz, Schwede, Sullivan. A large part of sky observed. 85 Leonids; 17 other meteors.

7:15-8:15. Miss Calvert and Morgan. Half of sky. 105 Leonids; 13 other meteors.

8:20-9:20. Same observers. 187 Leonids; 17 other meteors. Half of sky.

9:30-10:30. Same observers. Half of sky. Part of sky thick. 158 Leonids; 3 other meteors.

No systematic count was kept after 4:30 A.M., Central Standard Time (10:30 U.T.), but the meteors continued at about the same rate until daylight.

Most of the meteors were of the second magnitude or brighter. The general color seemed to be yellow, but four or five extremely brilliant ones were blue. From 5 to 10 of the meteors were so bright that an observer facing the opposite

direction would see the outside of the observatory domes lighted up. Most of the meteors had trails which in a few cases were visible for several minutes.

Most of the shower was over by the following night, when the number of meteors observed was:

November 18. Observers: Miss Calvert, Mrs. Morgan, Crump, Le Fever, Keenan, and Morgan. Approximately half of sky observed.

5:55-6:55	5 Leonids	37 others
6:55-8:00	10	21
8:10-9:15	12	9

Most of the meteors which were not Leonids seemed to come from a radiant in Taurus or Auriga.

W. W. MORGAN.

GENERAL NOTES

Professor William R. Ransom, of Tufts College, was elected president of the Bond Astronomical Club at the first meeting of the season at the Harvard Observatory. (*Science*, October 24, 1930.)

Dr. Giorgio Abetti, director of the Royal Observatory at Arcetri, Florence, Italy, addressed the Amateur Astronomers Association in New York City on November 11. His topic was "Galileo and Astronomy in Florence." Dr. and Mrs. Abetti have been in this country, visiting various observatories, since last july.

Dr. Harlan T. Stetson, Director of the Perkins Observatory, Ohio Wesleyan University, gave the following lectures during the month of November:

"Sun Spots and Radio," before the American Optical Society of Rochester, New York, November 3, 1930. "Sun Spots, Radio and the Weather," before the Pittsfield Section of the American Institute of Electrical Engineers, at Pittsfield, Massachusetts, November 4, 1930. "Sun Spots and Radio Reception," at Cornell University, November 19, 1930. "What are the Stars," before the Brooklyn Institute of Arts and Sciences, New York City, November 21, 1930.

American Astronomical Society.— The forty-fifth meeting of the American Astronomical Society will be held at Yale University, New Haven, Connecticut, from December 31, 1930, to January 3, 1931, according to a statement issued by the secretary, Professor R. S. Dugan.

The Mathematical Association of America.— The fifteenth annual meeting of The Mathematical Association of America will be held in Cleveland, Ohio, December 31 and January 1, in affiliation with the meetings of the American Association for the Advancement of Science and the American Mathematical Society. The official headquarters for the Association will be the Hotel Statler.

The Astronomical Society for Amateurs in Chicago, mentioned on page 512, has, we are informed, found it necessary to modify its program in certain respects. Because of the existence of The Chicago Astronomical Society, which is now undergoing reorganization, it is thought unnecessary to organize another society of a similar nature. Therefore, the efforts of the astronomically inclined members of the Pickwick Society will be joined with those of the members of the already existing organization.

The American Association for the Advancement of Science will hold its annual meeting in Cleveland, Ohio, beginning on Monday, December 29, and continuing throughout the week. Dr. Robert A. Millikan will give the retiring presidential address on Monday evening.

Zodiacal Light Notes

From Mr. J. A. Hess, president, Canal Zone Astronomical Society, a letter has been received expressing interest in Zodiacal Light observations and promising reports from that station.

Mr. Ivan L. Thomsen, Dominion Observatory, Kelburn, Wellington, New Zealand, has sent reports of observations made by Mr. McIntosh, Auckland, Lat. 36° 52′ S.; Long. 174° 47′ E. and Mr. A. G. C. Crust, Wellington, Lat. 41° 18′ S.; Long. 174° 47′ E.

New Zealand Morning Observations.—Mr. McIntosh made seven observations between April 29 and July 31. Time of observations ranged from 3:00 to 6:00 A.M. On April 29 he found the base 1° north of Mars in Pisces; the apex, very faint, was at Delta Capricorni; brightness at base equal to the Galaxy in Scutum. On May 4 he found the outline of the north boundary at Gamma Pegasi, Gamma Piscium, Theta Aquarii to Delta Capricorni; thence down the south boundary to Delta Aquarii, Eta Ceti, Theta Ceti, and the horizon. On July 29 the Light appeared "as a faint searchlight," not conical as in May but straight and narrow; apex was at 30 Piscium, width near base extended from the Pleiades to Lambda Tauri. By plotting the data it is seen in each instance that the apex was south of the ecliptic. In the northern hemisphere it is north of the ecliptic.

New Zealand Evening Observations.—Mr. Crust made observations on July 23 and August 18. On July 23 at 7:00 P.M. he found the inner zone extending from Alpha Leonis near the horizon to Spica. The Light was bounded on the south edge by a line running through Phi Leonis and on the north edge by a line running through Theta Virginis and Theta Leonis. On August 18 the boundary on the south edge was marked by Theta Crateris and Delta Corvi, on the north edge by Delta Virginis and Alpha Librae; apex was between 39 and 40 Scorpii. The Light was very faint. Again the apex in each instance was south of the ecliptic. Organized one year ago the Aurora and Zodiacal Light Section of the N. Z. Astronomical Society has contributed reports which are most welcome.

Morning Observations.—The writer made observations on October 21, 25, 26, 31, November 2, 3, 4. On all other possible mornings cloudy weather interfered. On October 21 at 3:10 A.M. the Light extended as a cone from the body of Leo to the apex a few degrees north of Mars in Gemini. Regulus was almost exactly on the south clear cut edge. At 3:50 the Light was noticeably stronger. About two-thirds of the Sickle of Leo was covered. On October 26 at 3:30 A.M. the Light showed faintly through Leo to Praesepe which was just clear of the south edge. At 4:30 the Light was much stronger, extending from Regulus to Virgo on the horizon. On October 31 at 4:30 the Light was strong through Virgo to Regulus, a fine, full luminosity. The major zone of the Light was well north of the ecliptic. Estimated breadth of the Light along the horizon was 20 degrees. On November 2 at 4:30 the Light showed strong along the western half of Virgo to the apex slightly east of Regulus. As dawn approached the lower part of the Light brightened and the upper part faded. On November 3 at 4:00 A.M. the Light was generally faint. It extended to Regulus and covered Denebola diffusely. At 4:30 Regulus was clear of the Light as also was Denebola. The lower

half of the Light was conspicuously bright, sharp-edged on the south horizon, breadth about 25 degrees. The beautiful apparition of the morning Zodiacal Light was well worth the discipline of early rising.

Gegenschein.—On November 3 at 4:00 A.M. the Gegenschein was observed in Aries below Musca; east and west diameter was about 20 degrees.

The time is approaching when the evening Zodiacal Light will be well placed for observation in our latitudes and it is hoped that some observers may find it convenient to send reports and diagrams.

W. E. GLANVILLE.

The Rectory, New Market, Maryland.

Note on Mars

The coming opposition of Mars occurs January 27, 1931, when the diameter of the planet will be 14".1. It will thus be one of the very remote oppositions. For the same solar longitude or season, the diameter of the planet 11".7 will be practically the same, on December 18, 19 that it was in 1929 on January 30, 31. Before these dates the planet was nearer us in 1929, after then it will be nearer in 1930, and should therefore be seen to better advantage. The vernal equinox was passed on November 6, so that the northern polar cap, which will be gradually turned towards us more and more, will be of its maximum size. As the snow melts the atmosphere of the planet will be filled with cloud. The lower clouds which like our own, and like the Martian deserts, are yellowish or brownish white as compared to the snow, when seen through the dense atmosphere of the planet are nearly as yellow as those of Venus. In point of fact these clouds and the deserts appear of practically the same color, and are often indistinguishable. As a result we may this year see what appear to be strange markings on the planet, but which are really the maria partially covered by clouds, and darkened in spots by heavy precipitation. The higher clouds are sometimes almost as white as the snow itself, and there are all intermediate shades of color between them and the lower ones.

The view, based on modern measures of the temperature of the planet, that the atmosphere of Mars is very rare, is due to an unfortunate comparison of the planet with the Moon. It should really be compared with the planet Jupiter. We all believe that the real surface of Jupiter must be very hot, yet the visible surface, that of its deep atmosphere, we know to be very cold. Jupiter is of course an extreme case. The real surface of Mars is much cooler, and the atmospheric surface even near the limb, where the heat of the planet cannot penetrate it in our direction and affect our instruments, is much warmer than that of Jupiter. Near the center of the disk, where there is less atmosphere between us and the surface of the planet than there is at the limb, we get a truer measure of the temperature of the real surface. Nevertheless it must certainly be warmer than the measures indicate, owing to the blanketing action of the dense atmosphere and the lack of oceans to temper the extremes of heat. Indeed we know that in the same latitude as northern Hudson's Bay, the Martian snows melt and disappear in their March and April, while ours in the same terrestrial months, according to the Weather Bureau, are disappearing only in southern Missouri and Kentucky. (Report on Mars, No. **31**, 1925.)

The formation and development of the northern marshes, corresponding to our *tundra* in Siberia and northern Canada, will be of interest to watch, and the deep blue color of Acidalium, and later of Euxinus, at the northern end of the Syrtis, should be conspicuous. Any changes observed in the size and shape of the

latter should be very carefully drawn. These changes are rapid, occurring from night to night. Other changes may be noticed, notably the appearance of the greens later, in the southern maria. They are by no means as conspicuous as the blues of the northern hemisphere, however, being mixed with grays as we find in the case of our own woodlands, when seen through a considerable length of atmosphere. Broad gray bands may also be seen, taking the place of some well-known canals, and crossing the tropical deserts in a more or less meridional direction.

WILLIAM H. PICKERING.

Private Observatory, Mandeville, Jamaica, B. W. I., November 15, 1930.

BOOK REVIEWS

Star Clusters, by Harlow Shapley, Harvard Observatory Monograph No. 2. (McGraw-Hill Book Co., New York, 1930. $3.00.)

To the investigator and student this Harvard monograph will be especially welcome as a reference work. It is essentially a résumé of the author's development of photometric methods of determining the distances and spectral composition of star culusters and the modification of his ideas of cosmogony due to the developments within the last ten years. Outside of the discovery and classification of clusters in general and the classical determinations of the distances of galactic clusters from their motions, their history may be said to begin with Shapley and upon his researches upon clusters our modern conceptions of the size of the sidereal universe are largely based. When one realizes that the results presented and discussed in this volume are based upon over 150 investigations at Mt. Wilson and Harvard by the author and his collaborators alone and published in as many separate papers, mainly in the *Astrophysical Journal, Proceedings of the National Academy,* and *Harvard Bulletins* from 1914 to the present, he may have some conception of the boon it is to the student of the subject to have these investigations summarized and analyzed by the author himself.

Naturally the greater part of the volume is devoted to explanation and application of the methods used in the determinations of cluster distances. The four methods used are based upon four assumptions, as follows: (1) That the variable stars which are found in great numbers in some of the clusters are comparable with those with a similar type of light variation in the galactic system, the Cepheid period-luminosity relation; (2) That stars of similar spectrum or color-type have mean luminosities equal to their galactic prototypes; and (3, 4) That the globular clusters have roughly the same absolute dimensions and content, so that relations exist between angular diameters (3) or integrated magnitudes (4) and distance. The first method is by far the most powerful of the four. The shape of the period-luminosity curve has been quite definitely established from observations of several hundred variables in a dozen star clusters and clouds, and with the revision recently adopted by Shapley there does not seem to be much probability of an appreciable error in the zero point. Among the clusters rich in variables it is found that method (2) gives distances in good agreement with method (1) and this method is universally applicable. Both these methods, however, necessitate a great amount of detailed work and so far have yielded the distances of but 48 clusters. The last two methods do not give the accuracy of the first two but when calibrated by methods (1) and (2) have the advantage of quick application. Shapley estimates that by using two or more of these methods the distance of the

average globular cluster is determined with a probable error of about 15 per cent. The distances so determined range between 18,000 and 184,000 light years.

From the distances separating some of its stars and star clusters, the diameter of the Milky Way system is found to be 225,000 light years, somewhat less than the 300,000 light years assigned in 1918, and its thickness is about 1/10 as great. From their distribution the center of the system is located in Sagittarius at a distance of 50,000 light years from the Sun. Studies of galactic rotation indicate a somewhat smaller distance, about 30,000 light years. While recent studies by Trumpler and van de Kamp support Shapley's conclusion that general obstruction of light in space appears to be of small importance in the measurement of distances up to 100,000,000 light years, both find evidence of pronounced absorption of light in and near the plane of the galaxy. This may account in part for the disagreement noted above in the estimates of the distance of the galactic center.

The discovery that the spiral nebulae were not systems comparable in size with the Milky Way system coupled with the discovery of several "clouds of nebulae" of great distance and size have led Shapley to the conclusion that the Milky Way system is in reality a super-galaxy comparable to these clouds of nebulae, such as those in Coma-Virgo and Centaurus, rather than to the island galaxies, such as the Andromeda nebula. Our system is "neither an uncommonly great spiral nor a single unified stellar system like the Magellanic Cloud on a grand scale; rather it is a super-galaxy—a flattened system of typical galaxies." This interpretation "removes the anomaly of the status of our system in the stellar universe."

Whatever may be the ideas of others as to the shape, size, and content of the sidereal universe, Shapley has in this volume presented a mass of evidence which forces one to have confidence in his observational results and to give serious consideration to his theory. The observational results are summarized in two appendices; A, a catalogue of all known globular clusters and B, of the galactic clusters. A practically complete bibliography of papers bearing upon star clusters is given in Appendix C. Of considerable interest also are numerous suggestions throughout the text of studies which ought to be undertaken and reports of various investigations already started at various institutions. This volume is recommended not as light reading for the *dilettante* but as of exceptional value to the student.

R. E. W.

A Catalogue of Bright Stars, by Frank Schlesinger. (Yale University Observatory.)

A Catalogue of Bright Stars, just issued by the Yale University Observatory, finds a welcome place as one of the most important astronomical publications of the year. Professor Schlesinger is to be congratulated for the issuance of a volume quite as important to statistical and astrophysical investigators as to workers in observational astronomy.

Here are gathered together on a single page the known vital statistics relative to all stars brighter than the 6.5 visual magnitude. The catalogue also includes some of the stars below this magnitude limit.

For a star catalogue to appear and not to contain a new sequence of numbers peculiar unto itself is a novelty. The fact that the catalogue adopts the sequence of numbers of the *Harvard Revised Photometry,* thereby avoiding a new numbering schedule, is a feature not to pass unnoticed.

For every star is given the Flamsteed or Bayer notation, with the corresponding number in the *Durchmusterung.* Another column gives the number in the

Preliminary General Catalogue by Boss. Thus one finds about all to be desired so far as the identification of the objects is concerned. The coordinates of the stars are given for the nearest minute of Declination and second of Right Ascension, for the year 1900. The coordinates have been checked and revised to secure accuracy to that degree. The adjacent columns give the following: photometric (visual) magnitude, as taken from the *Harvard Revised Photometry;* spectral type, from the *Draper Catalogue;* proper motion in both coordinates; values of parallax, and of radial velocity, compiled from the most reliable sources. Many of the values of parallax and of radial velocity are from manuscript files of hitherto unpublished data.

The table of remarks contains additional important information not assignable to the foregoing columns.

The *Catalogue* will find constant use in the library of every working observatory and will become an important asset for the serious amateur.

The four appendices add greatly to the usefulness of the volume. Appendix I is a conversion table for transforming Right Ascension and Declination into galactic coordinates. Appendix II defines the newly adopted limits for the constellations internationally agreed upon. Appendix III follows with the three-letter international abbreviations for constellation names. Appendix IV makes instantly available the Right Ascension of all stars whose Flamsteed number or Bayer letter is known. The advantage of having made generally available such cogent data in a single volume of 208 pages should in itself be a continued source of satisfaction to Dr. Schlesinger and his Yale associates, and prove some compensation for the work involved in its preparation.

One can hope that as further data become available, a supplementary volume may be issued extending the information to fainter stars.

HARLAN T. STETSON,
October 27, 1930. Director of Perkins Observatory.

Atti del Congresso Internazionale dei Matematici, Vols. I and II, edited by Nicola Zanichelli. (Società Tipografica già Compositori, Bologna, 1929.)

Two large sized volumes of 338 and 365 pages containing a record of the events of the session of the International Congress of Mathematicians held in Bologna, Italy, September 3-10, 1928, have been issued. The total number of delegates in attendance at the session was 1116, of whom 76 were from the United States of America. In the first volume are found the names of the officers of the congress, beginning with the president, Benito Mussolini, head of the Italian Government; also the names of the members of the several committees and a complete list of names of delegates or "congressists" as they were called. From page 135 to the end the book are found sixteen papers which were presented before the congress as a whole by some of the leading mathematicians of the world. Of these, six are in Italian, five in French, three in German, and two in English.

The second volume is given entirely to the list of papers which were presented during the session. Additional volumes, we understand, are to follow.

These volumes, therefore, not only furnish a record of the occasion, but also constitute an important addition to the literature of mathematics.